THE MODEL ENGINEER

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The MODEL ENGINEER

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25TH MAY 1950 VOL. 102 NO. 2557

SMOKE RINGS

Our Cover Picture

● A FULL-SIZE railway train, in an ordinary street, seems to grow to about double its normal size! This effect is, of course, due to the fact that the average street lacks the spaciousness which, even allowing for our restricted British loading-gauge, is to be found all round most railways.

However, in Britain, there are only a very few places where full-size trains can be seen running through ordinary streets; one of these places is the popular south-west coast resort Weymouth. This town is the starting-point of one of the cross-Channel services between England and the Channel Islands. The boat trains are permitted to run down from the Town station to the Quay station where they draw up alongside the boats. The maximum speed for this run is 5 m.p.h., and special engines are employed because main-line engines are not allowed in the streets.

The engine seen in the photograph is No. 2195, *Cwm Mawr*, a 0-6-0 saddle-tank. She is really very small, for a full-size locomotive, but in the picture she seems to have assumed massive proportions. She belongs to British Railways, Western Region.

"M.E." Exhibition Entry-forms

● ENTRY-FORMS for the Competition section of this year's "M.E." Exhibition are now available, and application should be made to: The Manager, THE MODEL ENGINEER Exhibition Offices, 23, Great Queen Street, London, W.C.2. The forms should be filled up and returned by competitors not later than Monday, July 3rd, 1950. Including the Model Aircraft section, there are no fewer than 28 separate classes for entries, and they should cover everything that amateur craftsmen with mechanical inclinations are likely to make.

We think we should remind readers that the exhibition will be held, this year, from August 9th until 19th. The venue will be, as usual, the New Royal Horticultural Hall, Greycoat Street, Westminster, London, S.W.1.

Another "M.E." Exhibition Loco. Prize

● MR. MICHAEL C. BRADBROOK, of Ealing, has been kind enough to donate a prize of £1 1s. od., to be awarded at the discretion of the judges to the best 3½-in. gauge, coal-fired, passenger-hauling steam locomotive. This award is to be known as the Michael C. Bradbrook Prize.

A Model Car Club for Hertfordshire

● MR. J. JONAS, 291, Shantoc Hall Lane, Bovingdon, Herts, informs us that a new model car club, of which he will be hon. secretary, is being formed in the Watford area. There are already twenty-three members and they are now searching for a permanent clubroom and track in or near Watford.

This will be heartening news to a great many model car enthusiasts in that area and we sincerely hope that any reader who may be able to offer help in the way of suitable accommodation, or information which might lead to such an acquisition, will not hesitate to contact Mr. Jonas at the above address.

That Unusual Steam Roller

● THE PHOTOGRAPH reproduced on page 496 *ante* has caused many readers to write in to record personal recollections and observations of such rollers. All our correspondents recognise the machine as a product of Robeys of Lincoln. The type was developed specially for rolling asphalt " carpets " on roads, but the more usual form had only one rear roll. According to Mr. G. A. Pickett, of Bedford, the roller seen in Mr. Kruse's photograph is one of three, all of which were originally built as two-roll jobs but were rebuilt with the second rear roll by the owners, Wirksworth Quarries Ltd.; the inner and outer fireboxes are vertical cylinders and are *not stayed*, and the working pressure is 250 lb. per sq. in. Mr. Pickett comments upon the extraordinary speed of reversal; when the engine is rolling, it travels at much higher speed than the conventional steam roller, the driver throws the lever right over without closing the regulator. This is one of the features which makes this machine far superior to any other for this particular job; for it must not pause on the soft surface of freshly-spread asphalt, and for obvious reasons.

Mr. J. A. Smith, of Liversedge, Yorks, mentions some similar rollers which he knew about twenty years ago, and he calls to mind the circular stayless firebox, the tandem engine and the quick-reverse type of valve-gear. He, also, doubts if the machine was built with three rolls, and suggests that the third one was added by the owners in order to overcome the tendency which all rollers have of forming waves in the ashpalt surface.

Mr. F. H. Beynon, of Torquay, some years ago saw a two-roll engine of this kind working in that town. But at the moment of writing this note, a letter has arrived from Mr. H. Barker, of London, W.4, who definitely identifies the engine in Mr. Kruse's photograph as one of three which were well known to him because he and his brother drove them, at one time; he writes: " This roller was built by Messrs. Robey & Co., Lincoln, in, I believe, May, 1929; of course, it was turned out as an ordinary tandem. I was fortunate enough to bring this roller out of the shops of Messrs. H. Goode, Royston, Herts, after its conversion, and it was later driven by my brother for several years; its registration number was VL 1412. I took over the next conversion, VL 2374, and drove her for some time. The last one I unloaded new on October 5th, 1930, at St. Ives, Hunts. It was VL 2773.

" The idea came in about 1936, when a Mr. Arnold, of Kelvedon, Essex, had a Yorkshire boiler and engine converted into what he called Arnold's Waveless Roller. It did not achieve much popularity, on account of its rather cumbersome nature; but Wirksworth Quarries Ltd. tried it and found it successful, so all three of their engines were converted."

Mr. S. W. Miles, of Wolverhampton, saw a two-roll engine of this type at work near Stafford about six years ago, while Mr. W. J. Hughes questions our reference to the " usual locked, worm-geared steering connected to a tiller over the front roller " and points out that this was *not* " usual " for steam rollers. He is right, of course; but the arrangement we mentioned *is* very often seen on Robey rollers. Incidentally, Robeys still feature *steam* rollers in their catalogue, and Mr. Hughes quotes from the description of one which states that " the old-fashioned chain steerage has been eliminated in favour of worm and quadrant type which prevents front roll stagger."

The Worth of a Hobby

● JUST LATELY, there appeared in a well-known newspaper some comments to the effect that the chief attraction of a hobby was the worthlessness of it; there is, presumably, no practical value or utility and, therefore, no benefit to the community to be found in mere hobbies. What a travesty of the truth! Imagine the effect that would result if it were possible to prevent anyone taking up a hobby. The ideas expressed in that newspaper could only have come from a writer who himself had no hobby; or, if he had, then it must be a particularly worthless one. Certainly, he could never have heard of model engineering, to mention only one of many hobbies which *are* worth the time spent on them.

There is no need for us to emphasise the fact that *our* hobby is not a worthless one; it has a very definite practical value which only the most prosaic amongst us could fail to realise. Of course, the only test of the real value of a hobby is what the hobbyist himself makes of it; but, if the hobby involves the mere creation of something for the love and excitement of creating it, the time involved has undoubtedly been well spent, even though there are some people who would not admit this.

Where skill, patience, perseverance and craftsmanship are brought into play in the creation of anything at all, the result can be nothing but good, whatever the circumstances; and the same is true of a hobby, the practice of which involves the use of the faculties just mentioned. The ultimate benefit to the community may often be difficult to discern; but that is no reason for stating, categorically, that there is is no benefit at all! The plain fact is that any hobby, provided that it keeps one's faculties alert and interest alive, is bound to benefit somebody and, therefore, is good in itself. The man who has no creative hobby to occupy his spare time is to be pitied, and we can only imagine that it was some such person who wrote the ideas in the newspaper to which we have referred.

AMATEUR FOUNDRY WORK

A Model Engineer's Record of Failures and Successes

by A. L. Headech

I HAVE been invited to write some articles on this subject with a view to helping, if possible, other interested model engineers to produce castings of their own. It is with some hesitation that I venture forth on this work, as my experiences have not always been successful, and I do not claim to be an authority on these ancient crafts. However, as I have met with some rewards in the past years, through my labours to this end, I will do my best to enlighten other fearless adventurers.

There are quite a number of publications on the subject of moulding, but I am afraid that very little indeed would be of value to the beginner. These works are written by professionals for the use of workers in foundries, and students who wish to extend their knowledge. Information from these books can be helpful after considerable experience has been gained by experiment in the home foundry.

The making of an engine either steam or petrol, from the drawing board to the working model entirely by oneself has always fascinated me. It was this sense of completeness of achievement, which prompted me to try to dispense with commercial castings, and cast some of my own. It is obvious, therefore, that having made the necessary drawings, parts of which could not be machined from the solid would have to be cast, and would need some sort of patterns.

Mahogany is an ideal wood for the purpose, as it is often straight grained, dry, and not liable to warp after construction is completed. Other timbers that may be tried are yellow pine, American whitewood, beech, walnut and sycamore. My first attempts at casting were from a pattern of a crankcase needed at the time for a 2 c.c. two-stroke model aero engine of my design.

The pattern was small and fairly straightforward in shape and not too difficult to "draw" from the sand. The surface of the pattern was painted with a red lacquer, but I subsequently learned that it should have been finished with either clear brush polish, or orange pattern varnish. These varnishes can be obtained easily from firms specialising in patternmakers' materials. Orange is used nowadays for most patterns required to produce non-ferrous castings. Three coats are usually sufficient to give a good surface to the pattern, enable it to draw readily from the sand, and also prevent moisure being absorbed by the pattern. Careful rubbing down between coats is necessary, as the grain of the wood is inclined to swell and become roughened. Before I could proceed with the casting, "a moulding flask" to hold the sand had to be constructed. This consisted of two shallow boxes of dovetailed construction and having open ends. Small blocks were screwed and glued to the sides to enable locating pins to be fitted for registering accurately the two parts of the flask. Moulding and bottom boards were also made, having wooden cleats

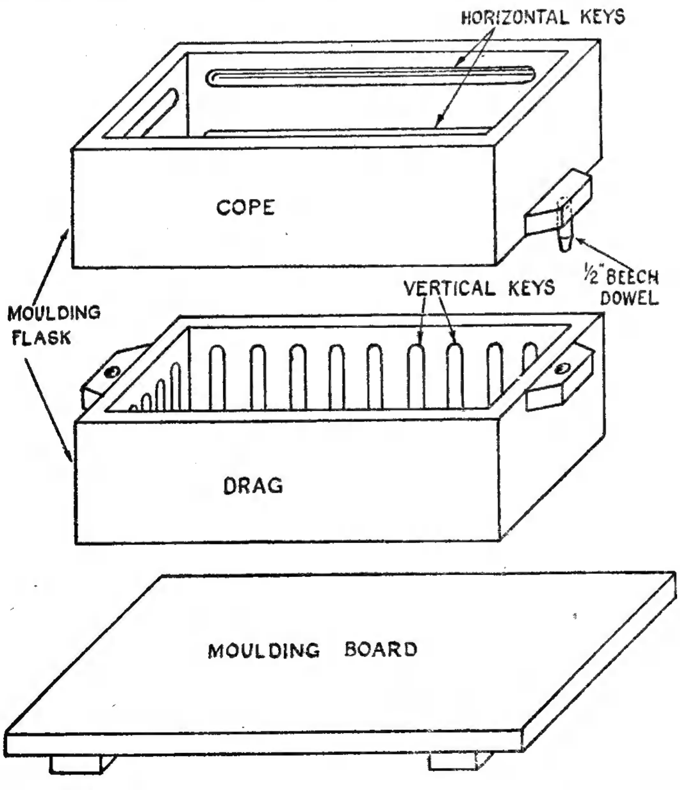


Fig. 1. Constructional details of moulding flask, showing two methods of keying sand to inside surfaces

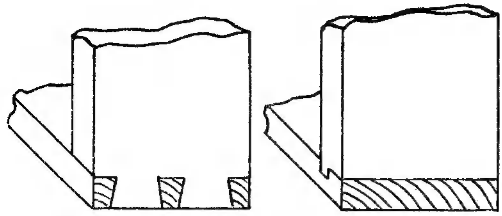


Fig. 2. Alternative methods of joining the corners

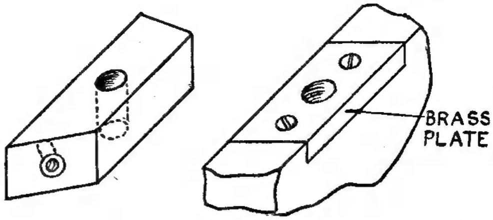


Fig. 3. Two ways of locating moulding boxes

attached underneath to prevent warping (Figs. 1, 2 and 3).

The following items will be required before actual moulding can take place :—

Moulding sand—from a local foundry.
Parting sand—from a local foundry.
Sprue and riser pins, Fig. 5.
Moulding and gating trowels, Figs. 4 and 12.
Rammers, Fig. 6.

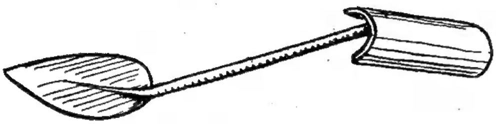


Fig. 4. Combined trowel and gate cutter

Venting wire, Fig. 7.
Draw spike and rapper, Fig. 8—(an old flat file will do).
½-in. flat camel hair brush.
A fine gauge sieve, Fig. 9.
(A sieve can be made from a shallow box. The bottom is removed and perforated zinc nailed in its place.)

Preparing the Mould

Having obtained the moulding sand from the foundry, and the various tools and equipment been acquired, work may begin on the actual mould. The sand should be just damp enough to give a clear impression when grasped in the hand, but not wet enough to stick to the skin. It should be well sieved to maintain fineness, and prevent lumps. The moulding board is placed on the bench and the inverted " drag " placed on it. The drag is the box without the dowels or the lower portion of the moulding flask Fig. 10. The pattern is placed in a convenient position " cope face " downwards on the board. Fig. 11. Make sure that there is room for the placing of gates and runners, subsequently. Parting sand is now dusted over the pattern and board. The first layer of moulding sand is sieved in, completely covering the pattern and board to a depth of an inch or so. A few handfuls of sand are then put in and the rammer used. The ramming is a very important part of the procedure, and, if too hard, will not allow the gases to escape into the sand, and it may even cause an explosion. If the sand is rammed too tightly, a poor impression will result and probably the mould will break on rolling over, or in the extracting of the pattern. The right amount of

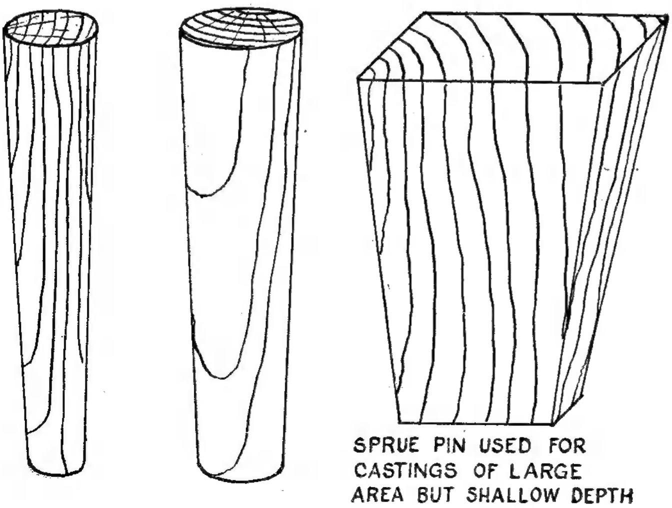


Fig. 5. Riser and sprue pins

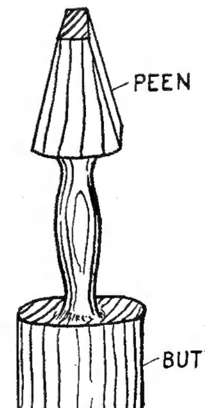


Fig. 6. Rammer

Fig. 7. *Vent wire (brass)*

Fig. 8. *Draw spike*

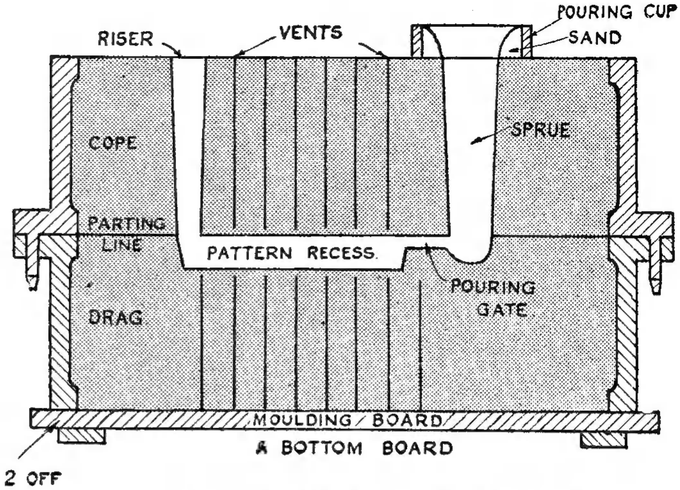


Fig. 10. *Section through a moulding flask*

pressure to use can only be learned by practice.

The ramming should be firmest at the edges of the box and less hard over the pattern. The large end of the rammer should be used for the middle, and the wedge-shaped end for the sides. Filling and ramming is continued till the sand is flush with the top. The surface of the sand can be levelled off with a piece of wood or with the correct trowel for the purpose, Fig. 12. Air vents are now made by stabbing the sand over the pattern and surrounding area with a piece of hard brass wire, like a knitting needle in shape, Fig. 7. There is no need to go down quite to the pattern, and, to prevent this, the fingers can act as a depth stop.

Now take the other board, called the bottom board and place this on the top of the drag, and grasping all firmly together, roll the box over. Take off the moulding board and the pattern will be visible flush with the surface of the sand, Fig. 13. Take the dusting bag (Fig. 13A), and cover the pattern and sand with an even, thin layer of parting sand—this is to prevent the cope stand sticking to the drag surface, and to facilitate a clean break. Place the cope into position and insert the sprue pin in a convenient place near the pattern, and the riser pin on the opposite side. In many foundries these pins are not used to form the sprue and risers. A hollow brass tube of thin gauge is provided to cut a hole in the sand from the impression to the top of the cope. The tube works in much the same way as a corer removes the centre of an apple. If the pins are used, either obtain help to hold them whilst the filling and ramming proceeds or anchor them by wire loops to the side of the moulding box, Fig. 14. This method was used very satisfactorily on one occasion when a complicated mould was required, and no help was available. The cope should be filled carefully in the same way as the drag and levelled off as before, the vent holes put in, and the pins gently rocked and extracted. Tap the sides of the moulding flask with a rammer to help to

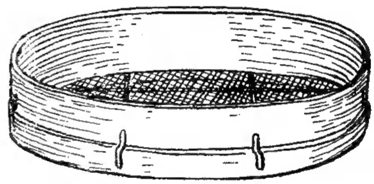


Fig. 9. *Riddle for sifting sand*

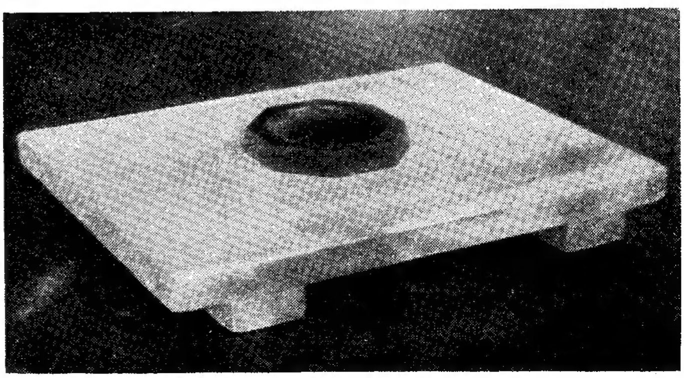
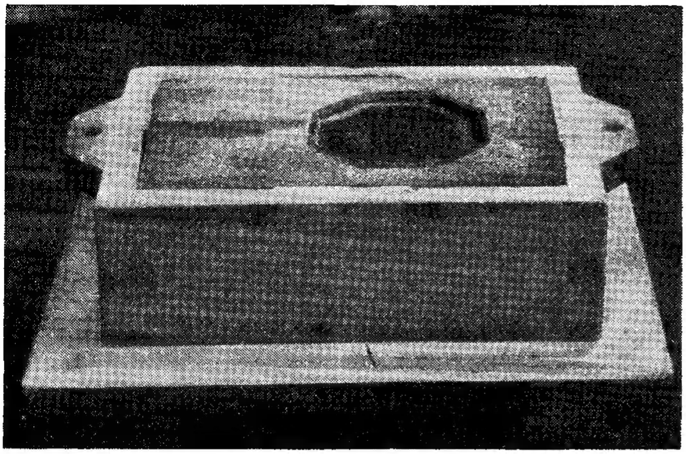


Fig. 11. *Ash tray pattern on moulding board*



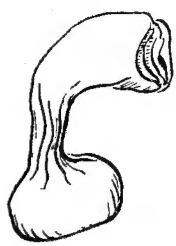


Fig. 13A. *Dusting bag*

Left—Fig. 13. *Showing pattern cope face upwards in drag half of moulding flask*

free the two parts and the pattern cleanly. Lift off the cope and lay one one side. Take a small brush and dipping it in water, lightly damp around the edges of the pattern. This will sharpen up the sides of the impression and prevent crumbling. Now insert the draw spike carefully in the centre of the pattern and gently tap the lower end of the rod near the pattern, Fig. 15. The tapping should be done in all directions to

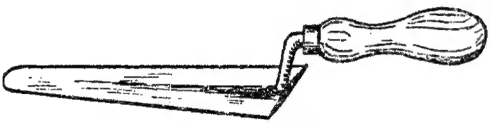


Fig. 12. *Trowel for levelling parting surfaces of the mould*

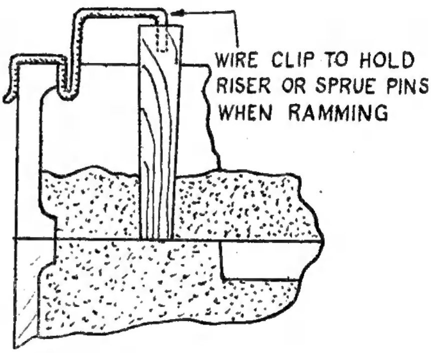


Fig. 14. *Simple method of holding pin*

loosen evenly the surrounding sand. Still tapping gently, lift the pattern vertically and remove from the drag. If sufficient draft has been incorporated in the pattern, a clean break should ensue, leaving a good impression of the form in the sand. Where small breakages have occurred, they may be made good by reinserting the pattern and carefully filling in the hollows with sand, using a small trowel.

Runners can now be cut into the top surface of the sand, away from the impression towards the sprue, Fig. 16. The gating trowel, of course, is used here, Fig. 4. A ¼ in. is usually deep enough for these runners, giving a channel in the sand

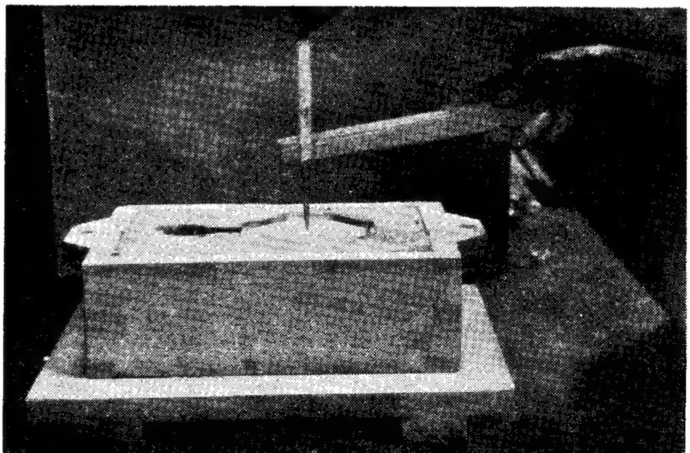


Fig. 15. *Rapping the pattern*

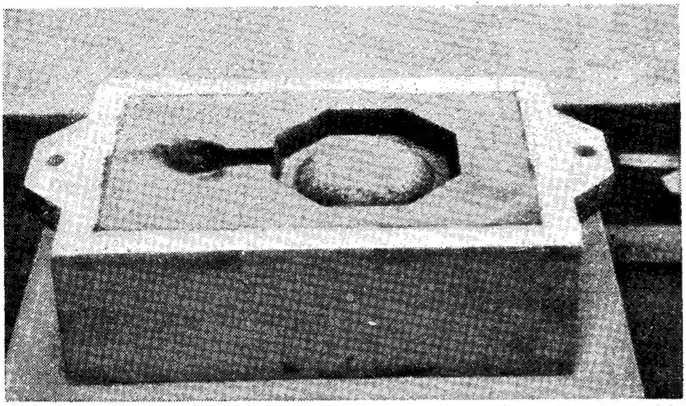


Fig. 16. *Drag before closing mould, showing pouring gate cut at side of impression*

will remove any sand still adhering, and leave a perfectly clean casting for subsequent machining. Where a casting has a cored hole in it, the core sand can be removed by a small trowel or stiff wire. A quicker method, of course, is a rotary wire brush on a flexible drive, but I feel this to be an unnecessary luxury. Readers following carefully the foregoing should not only be able to produce worth-while castings with practice, but find it also an absorbing branch of model engineering.

Small castings in aluminium alloy for i.c. engines, etc., can usually be cast from metal heated in a ladle by a blowpipe. This can be a tedious method, particularly when an air blast can only be produced by a foot bellows. But when expensive equipment is the alternative, it may be the only method. There is, of course, the domestic grate, and I have even had to press this into service by a tactful approach in the right direction. This method restricts activity to the winter months to some extent. The kitchen boiler is another avenue worth exploring as a suitable furnace. There can, though, be many reasons against the use of domestic appliances for this work, and, for those who are looking for an alternative method, I shall deal next with some of the more suitable types of furnaces which are obtainable commercially for melting the usual non-ferrous metals.

(*To be continued*)

of semi-circular form, about ½ in. wide. A spoon-shaped depression is cut just below the sprue (Fig. 16), to break the force of the in-rushing molten metal before it enters the mould. Again, any dross or impurities can often be left behind in the recess, allowing clean metal to make the casting. Assuming that the two halves of the mould are completed, they are now ready for closing, Fig. 17. A small pair of bellows are useful to blow out any particles of sand that may have dropped into the lower hollows of the impression. This point is very important, as these particles will cause weak projections and prevent surfaces cleaning up later on. The cope should now be carefully lowered into position, making sure that it is the right way round. A pouring cup can now be placed over the sprue hole and the funnel formed by pressing sand gently into the cup, Fig. 10. I have poured many castings without a cup being used, as the sprue has been of adequate diameter to enable the molten metal to enter easily. A point to remember here is that the larger the sprue, the sharper the casting will take the impression of the mould, due to the "head" of the molten metal before it sets.

Fettling of the Casting

After the metal has cooled down sufficiently the mould can be broken open. I always get a thrill at this time, as one can never be quite sure whether the casting will be a success or a failure. The casting can be gripped by tongs and the sand scraped away with a trowel. The runners, sprue and riser projections can now be sawn off and any rough edges removed with a file. A wire brush

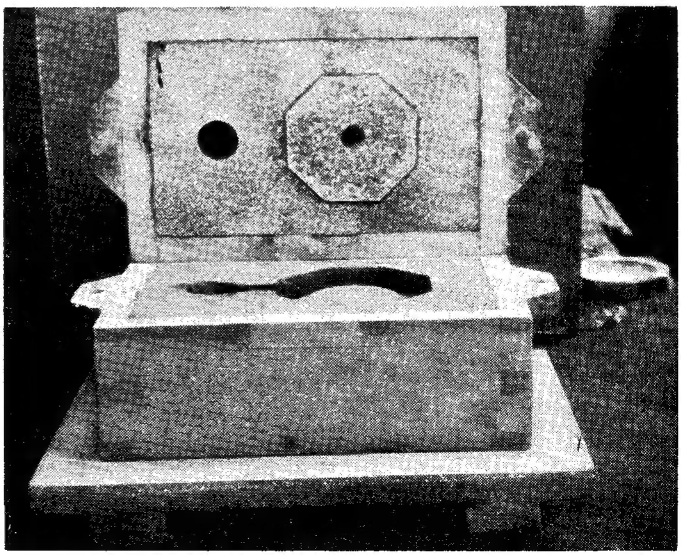


Fig. 17. *Cope and drag before closing. Note parting sand*

A Small Power Steam Plant

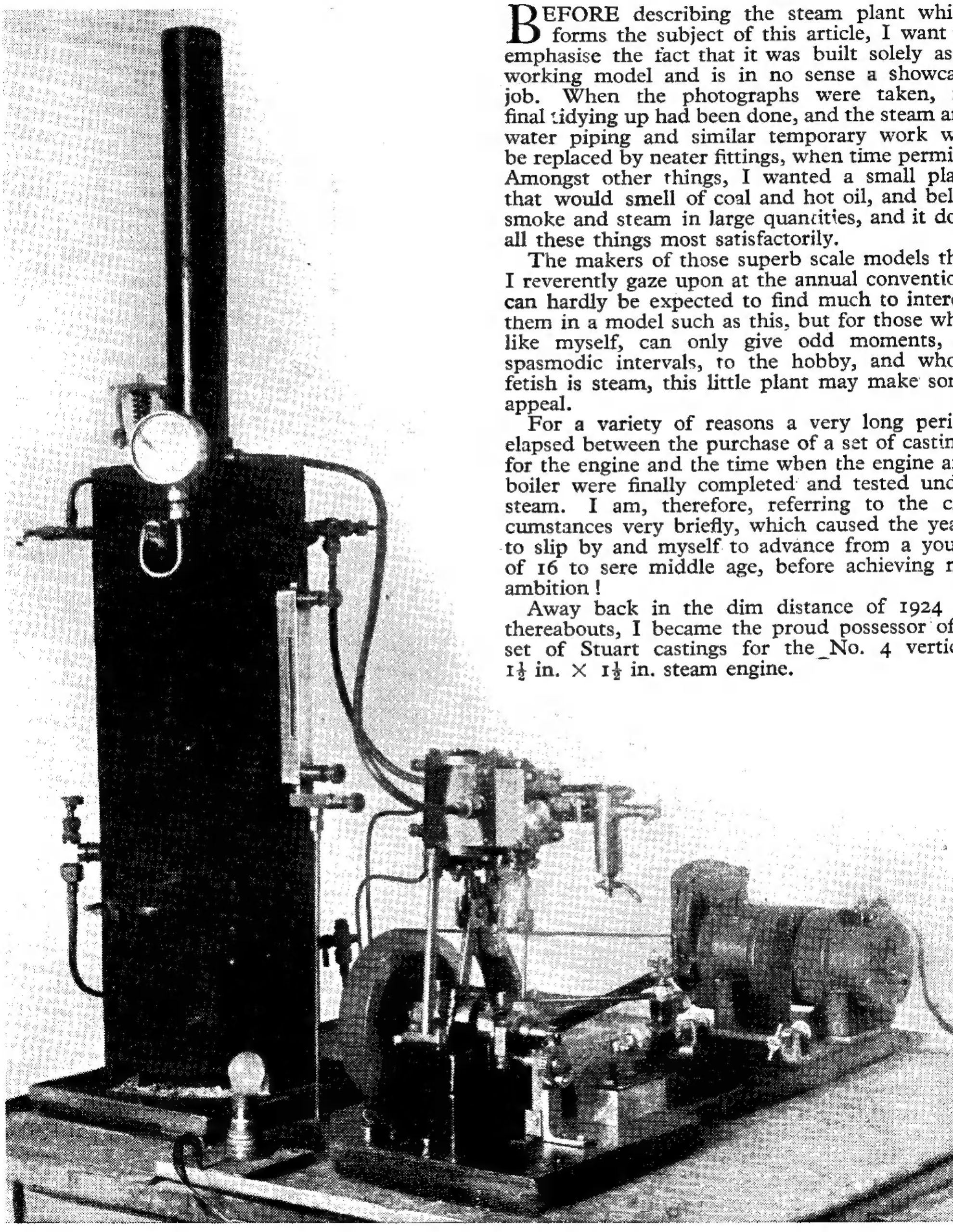
by T.W.G.E.

BEFORE describing the steam plant which forms the subject of this article, I want to emphasise the fact that it was built solely as a working model and is in no sense a showcase job. When the photographs were taken, no final tidying up had been done, and the steam and water piping and similar temporary work will be replaced by neater fittings, when time permits. Amongst other things, I wanted a small plant that would smell of coal and hot oil, and belch smoke and steam in large quantities, and it does all these things most satisfactorily.

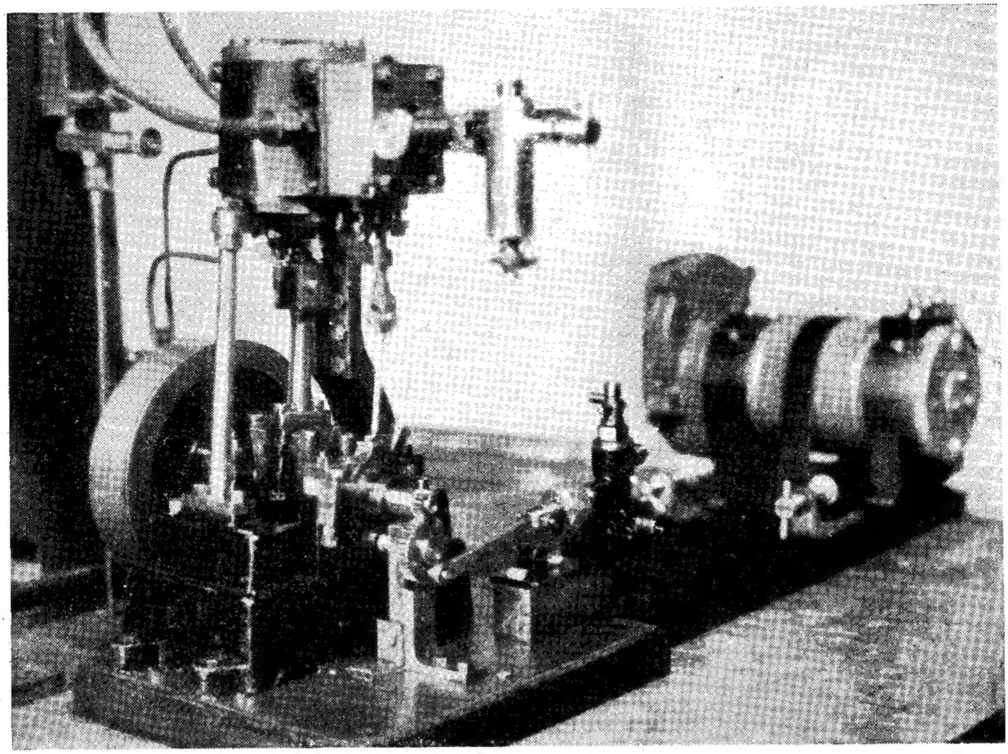
The makers of those superb scale models that I reverently gaze upon at the annual convention, can hardly be expected to find much to interest them in a model such as this, but for those who, like myself, can only give odd moments, at spasmodic intervals, to the hobby, and whose fetish is steam, this little plant may make some appeal.

For a variety of reasons a very long period elapsed between the purchase of a set of castings for the engine and the time when the engine and boiler were finally completed and tested under steam. I am, therefore, referring to the circumstances very briefly, which caused the years to slip by and myself to advance from a youth of 16 to sere middle age, before achieving my ambition!

Away back in the dim distance of 1924 or thereabouts, I became the proud possessor of a set of Stuart castings for the No. 4 vertical $1\frac{1}{2}$ in. $\times$ $1\frac{1}{2}$ in. steam engine.



General view of the complete plant—temporary feed water tank has been removed to make a cleaner picture

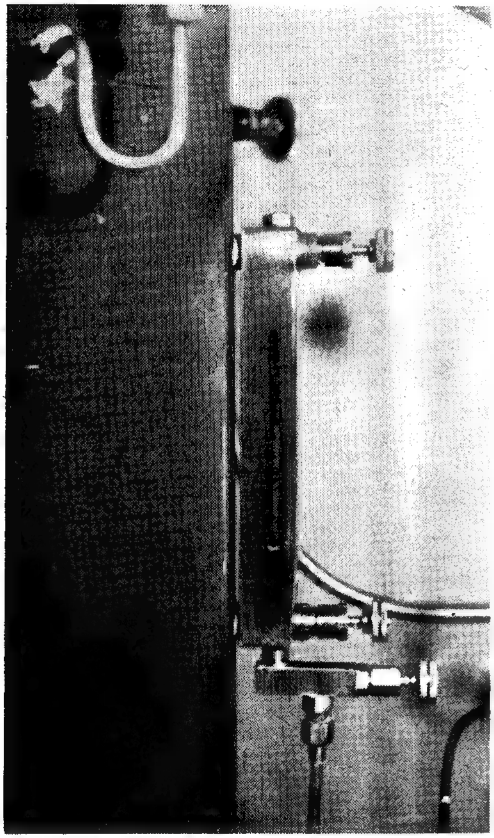


A close-up of the engine and generator

In those happy days I fondly imagined that a model engine could be made in about two weeks, and as a result my masterpiece when completed would hardly turn round. The cylinder had a special finish which made the piston a driving fit one end and a rattle fit the other, the crankshaft was out of line with the connecting-rod and not a single joint or working face was square or flat, so in disgust I dumped the thing into a box and forgot it. Not long after this, fate took a hand in my affairs and I found myself wafted to other lands, this wafting hither and thither having been a feature of my life from that day to this, and no model engineer needs to be told that the nomadic life is not the best one for the ardent model maker. Some time in 1944, during a short breather between wafts, I found myself in a position to gather all my belongings together under one roof for the first time since 1924. Many long-forgotten relics came to light and great was my surprise when from out of a spider-infested box, tumbled the grisly tangled remains of my engineering efforts of 20 years before.

At first the sight nauseated me, but after a bit, curiosity got the better of me and I laid out the wreckage, to see if anything could be done with it. After careful inspection it was decided that the main castings could be salvaged and converted into quite a respectable engine, and work was commenced on the cylinder. The bore was trued and lapped and a new piston of hard bronze was fitted. The gunmetal connecting-rod was scrapped, together with the crosshead and piston-rod, and these items were replaced by built-up versions in steel. The crankshaft was trued and new bearings made, these being bored in position on the saddle of my lathe, to ensure accuracy. Other small fittings were made, and a combined stop-valve and displacement lubricator was fitted to the valve chest cover, a pair of screw-down drains were fitted to the cylinder. This just about completed the engine. Once more the arbiters of my fate stepped in and I found myself on the move again, so further work on the model had to be shelved for about eighteen months, when circumstances permitted me to consider the construction of a boiler. I wanted one that would steam the engine at high pressure continuously so as to get a really good power output from the engine. At that time the largest copper tube I could get was 6 in. in diameter. This decided the outside diameter, and it also decided why the boiler has the proportions of a telegraph pole. I took the main dimensions of the boiler from Greenly's *Model Engineering*, adding an inch or so for luck, so that I could get a deep firebox. The firebox is 5 in. diameter and 10 in. high, while the boiler shell is 17 in. high ; $1\frac{3}{4}$ in. of which is taken up by the smokebox. There are nineteen $\frac{5}{8}$ in. diameter tubes and six 5/32 in.

copper stays, but as the tubes are silver-soldered at both ends I think the stays are almost superfluous. The whole boiler is bronze welded and I used a small B.O.C. outfit with Brazotectic rod. In places that needed something to run between the silver-solder and Brazotectic I used Cuprotectic. This runs like water and makes an excellent joint. The completed boiler was tested to 260 lb. per sq. in. water pressure and works at 100 lb. per sq. in. under steam. It



The three screw-down cock water gauge and brass guard

can supply far more steam than the engine can use even with the feed pump full on.

The grate is made in the same way as "L.B.S.C.'s," only, of course, is circular instead of rectangular and stands on four feet, the boiler being lowered over it. It is not attached to the boiler in any way. The usual mountings are fitted and comprise, water gauge, pressure gauge, safety-valve, main steam-valve, injector steam-valve, blower-valve, two check-valves and injector. The water gauge is of my own design and has three screw-down valves, to avoid the use of plug cocks. It also has a guard to prevent injury in the event of a glass bursting.

I now found myself the proud possessor of the main essentials of a steam plant so it became necessary to think up something for the engine to drive. The only suitable thing I had by me was a war surplus hand-cranked 7-volt 3-amp battery charging generator. All the gears were removed and a steel pulley fitted direct to the armature shaft. A set of slide rails was next made, and the engine and dynamo mounted on an oak base.

Time being one of my greatest problems, I used an ordinary hand-type boiler feed-pump which I had by me and converted it to run off the engine through a three-to-one reduction gear.

On "D" day the plant was rigged up in a small spare room and the fire lighted on natural draught without any bother. The only trouble came from the senior member of the household, who didn't see eye to eye with me over the absence of an extension chimney to convey the products of combustion to the outer world—the pious hope that it would just float out of the window proved an optimistic myth—most of it floated up to the ceiling and stuck there.

In due course steam was raised, and then the fun started, which was more than the engine did. Nothing would induce the flywheel to rotate, in fact the engine appeared to have seized solid. During my earnest endeavours to make the engine run I forgot that the blower was still on, there were so many leaks, the added roar of the blower was lost in the general uproar. I had a look at the pressure gauge and it showed 120 lb. pressure. The fire was white, and worst of all, there was no water in the gauge, the injector wouldn't work, and there was no hand-pump! Whilst wondering what a boiler-assisted exit from the room was going to feel like, there was an exceedingly loud bang and the pressure gauge shot across the room and hit the wall the other side. This solved the problem for me but reduced visibility to nil, and navigation to the door was entirely on dead reckoning; but once outside I was only too pleased to let it blow itself out at its leisure. When the fog had cleared, I found that by some piece of incredible carelessness, I had not even sweated the pressure gauge syphon into the nipple, and it was only held by friction prior to the "bang."

The engine was stripped, and nothing seemed amiss. On reassembly it turned over freely, but a second and third steam test proved abortive. The moment steam was turned on it refused to budge. I expect most readers have already guessed what the trouble was, but I'm not clever, and never see the obvious—it was, of course, connected with the different coefficients of expansion of bronze and cast-iron, and a few thou. off the piston put the matter right.

Although the engine was now satisfactory, I hadn't finished with teething troubles, a nasty leak had developed at the end of one of the tubes at the firebox end. To get at it for repair looked pretty hopeless, so I decided to try car radiator cement. There is no need to write and tell me how foolish I was, or what this stuff does to boilers, because I have found out for myself. In fact I could write a book on the subject. The fountains in Trafalgar Square

(*Continued on page* 742)

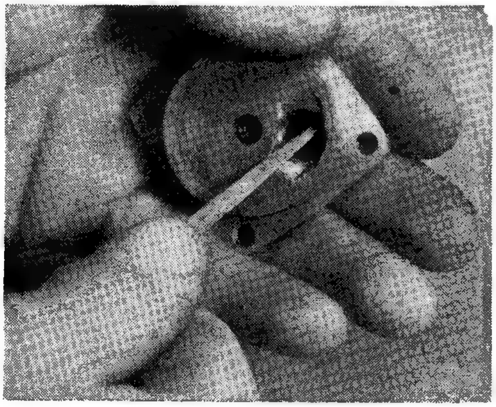
*The Elements of Maintenance

for 10-c.c. Racing Engines

by G. W. Arthur-Brand

THIS week, let [redacted] take the induction cover and the rotary disc as our first two items for treatment. It is most important that they be treated together, [redacted] upon their matching depends the correct breathing of the engine.

Slip the pin temporarily through the disc and locate the cover so that the ports are in the open position, and note whether the chambers on the inner face of the cover tally with the full extent of the opening in the rotary disc ; also, that the width is coincident.



Opening up the induction chamber in the rear crankcase cover. File until the edges of the chamfers form an angle of 90 deg. about a line drawn from the centre of the valve pin hole through the centre of the inlet orifice

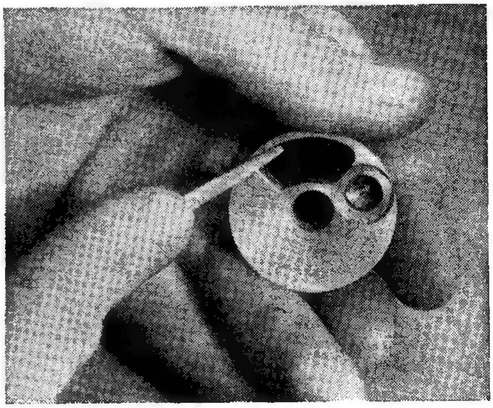
It will almost certainly be found that the chambers are rough and unpolished, and the edges jagged ; treatment in these cases will consist of the application of a fine file, as shown in the illustrations, followed by careful finishing with fine emery. In all instances, final polishing with Brasso or some other metal polish is required to give the desired results. Each part should then be well washed in clean petrol to remove all traces of the abrasive.

The upper leading edge of the rotary disc may now receive attention [redacted] shown. On no account touch the rear faces or in any way alter the existing dimensions of the orifice, unless you are quite experienced and know exactly what you are doing. The walls, however, may be scraped lightly and polished with good effect.

Now examine the rear face of the disc and the inner face of the induction plate. Are they highly finished, that is, to the extent of lapping ? If so, well and good ; if not, is there [redacted] very fine washer (0.001 in.-0.0015 in.) which fits between them on assembly ? If not, obtain one and fit it on reassembly.

While putting these parts away, we will get out the piston, gudgeon-pin and connecting-rod, since these are next on our list.

You will have already checked the piston for wear and concentricity, [redacted] I suggested in an earlier article when dealing with the liner, so all we have to do now is to make sure that the gudgeon-pin fits O.K. At the same time you might check the pin with your micrometer for concentricity and diameter, and if satisfactory replace it in its envelope out of harm's way.



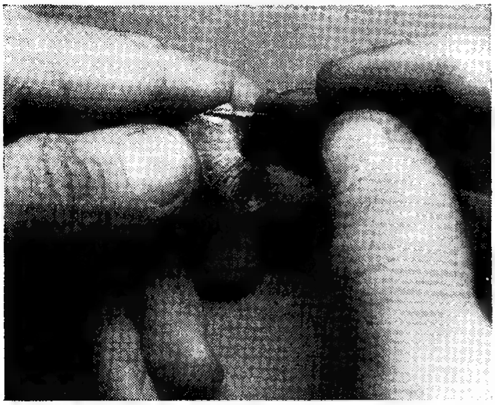
Smooth out the rotary disc gap to match the induction chamber and slightly round the forward leading edge

There are a number of methods by which the piston top may be polished, but for our particular purpose, I think that it would be advisable to stick to the small sharp scraper from the tang of [redacted] file. It is the most workmanlike and offers far fewer opportunities for things to go wrong. You must be careful not to remove too much material, however, as by doing so you will be lowering the compression ratio. As it is you will be doing so slightly, but it *might* improve performance, so don't worry about this until the unit has been reassembled and run in. Remember, we are only preparing at the moment for final tuning.

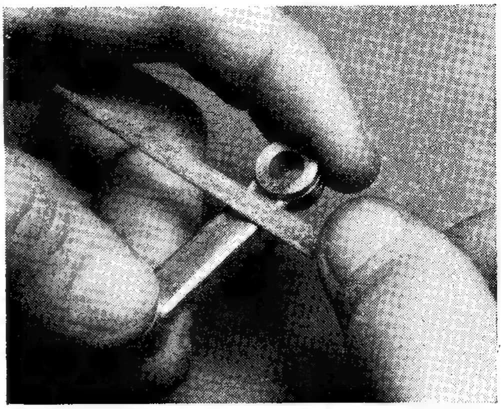
After scraping to a satisfactory finish, the piston may be polished as recommended above.

A close inspection of the connecting-rod will reveal whether it is in any way bent, or the big-

*Continued from page 679, "M.E.," May 11, 1950.



Using the small hand scraper, remove any rough material from the piston top and finish by gently rubbing with fine emery and metal polish



The connecting-rod might either be of abrupt rectangular section or rough finished. In either case, round off the edges with a fine file and buff or polish to a good gloss

or little-ends worn. A very exacting check is to pass appropriate diameter rods through both ends, a dial test indicator being then applied to both rods—the connecting-rod itself having been mounted vertically. A micrometer of suitable size may also be used, but care must be taken, as it will required a *very* delicate feel.

Assuming that the results are satisfactory (if they are not, get a new connecting-rod), I will leave you this week to remove all sharp edges and tool marks, aiming at a highly-polished streamlined section. Neither the width nor the centre thickness should, however, be altered, or you will run the risk of the most expensive noises in the not-too-distant future.

(*To be continued*)

A Small Power Steam Plant

(*Continued from page* 740)

are an insignificant dribble compared with the way the water behaved in the boiler after a shot of the radiator dope. This horrible stuff causes the most appalling priming, failed to cure the leak, but managed to put the fire out.

During one of these tests the water gauge burst with a full boiler at 90 lb. pressure. The pressure gauge incident was quite spectacular, but this was far better. In a matter of seconds visibility was nil and I couldn't find the boiler, let alone the gauge cocks, so once more in complete triumph the boiler blew itself out.

I must admit that this final disaster rather pained me, and I decided upon the diabolical scheme of making a present of the boiler to a fellow against whom I have a grudge, but after a little rumination, common lunacy prevailed and I plodded on.

The boiler was cleaned out with caustic soda and a ferrule made for the leaky tube. After some wangling it was driven home and sweated up with paste solder. The boiler is now as tight as the proverbial bottle.

There is still a lot of minor work to be done, but there is no doubt as to the success of this little plant, and I have had it running for hours on end, the boiler maintaining its full pressure of 100 lb. the whole time. The greatest difficulty is to prevent the safety-valve blowing continuously, and about the only thing which will shut it up for a spell is the injector.

The dynamo is much too small for the available power, as it gives its full 7-volts 3-amps. at only 25 lb. per sq. in., and I would welcome any suggestions for something more suitable.

I have rigged an extension chimney with an elbow which takes the exhaust out of the window, so that the plant can now be worked in comfort. Steam is raised in about thirty minutes on natural draught, and anthracite is the fuel used. The engine will run before any pressure is recorded, and as soon as the exhaust makes itself felt, an extremely fierce fire appears and the pressure rises rapidly to blowing-off point.

With this type of boiler the engine cannot be left running unattended for long periods, owing to the necessity for watching the water level, but to those afflicted with the steam-bug it is an added advantage!

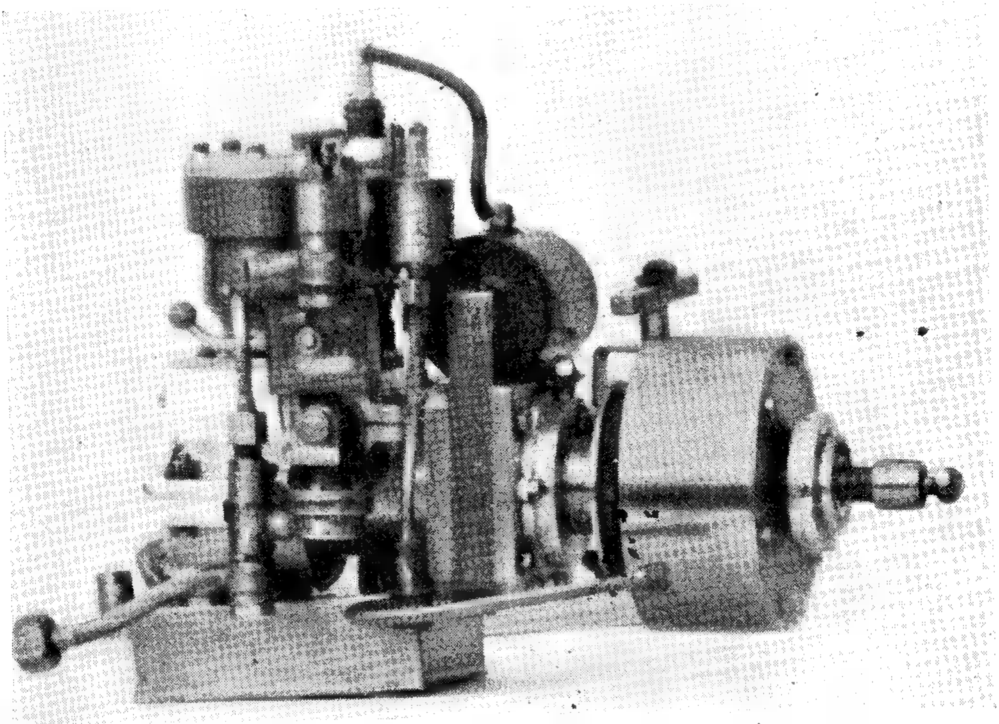
The boiler can be left in steam for two hours without attention. The anthracite seems to "slow combust," giving out enough heat to keep the pressure at about 60 lb. On re-starting the engine, the pressure drops about 10 lb. and then within a few minutes the safety-valve is blowing again.

Well, there it is, and I hope that the dwindling band of steam enthusiasts will be glad to see that there are others who still prefer the good old "push and pull" machine, with the smell of steam, hot oil and coal, the rumbling and hissing which only boilers can make, and the comfortable and exciting glow from the ash pit.

A 6-c.c. I.C. Engine for Boat Propulsion

by C. R. Amsbury

THIS engine was the eventual outcome of visits to several regattas. Examination of the " works " of quite a number of the i.c.-engined free-lance boats showed several points which did not appeal to me, as far as appearance and reliability were concerned.



View showing water pump and contact-breaker unit

First, I was not very keen on the use of an air-cooled engine in an enclosed hull. These either relied on the small amount of draught obtained through absence of glazing in the cabin windows, if a cabin was used, or the fitting of ■ fan on the crankshaft.

Secondly, when water-cooling was provided, the engine design often took the form of an existing air-cooled job, having the fins turned off and a jacket substituted.

In most cases the jacket was connected to inlet and outlet water connections on the hull by a large amount of " rubber plumbing." A circulating pump, if provided, was usually a separate unit, fixed in some odd corner, and driven by a belt.

Ignition was generally performed by battery and coil, which does not appeal to me for this work. A magneto gives better engine performance in my experience, and one has not the trouble of ensuring a fully charged accumulator before every visit to the pond.

The design described, although not fool-proof, does reduce the above objections to some extent.

This design was based on the " Kinglet " engine designed by Mr. Westbury, which does not, however, seem to be as popular ■ most of his other designs. Considerable alterations have been made, and no castings were used in its construction.

The crankshaft, of $\frac{3}{8}$ in. diameter, runs in three races and has the rotating magnet for the magneto mounted between the outer two.

The crankcase is of duralumin and has the magneto stator bolted permanently on to it.

The camshaft runs in two $\frac{3}{16}$-in. ball-races. It is fitted with a 7 : 1 worm reduction gear at one end and the cam operating both the water-pump and contact-breaker at the other end.

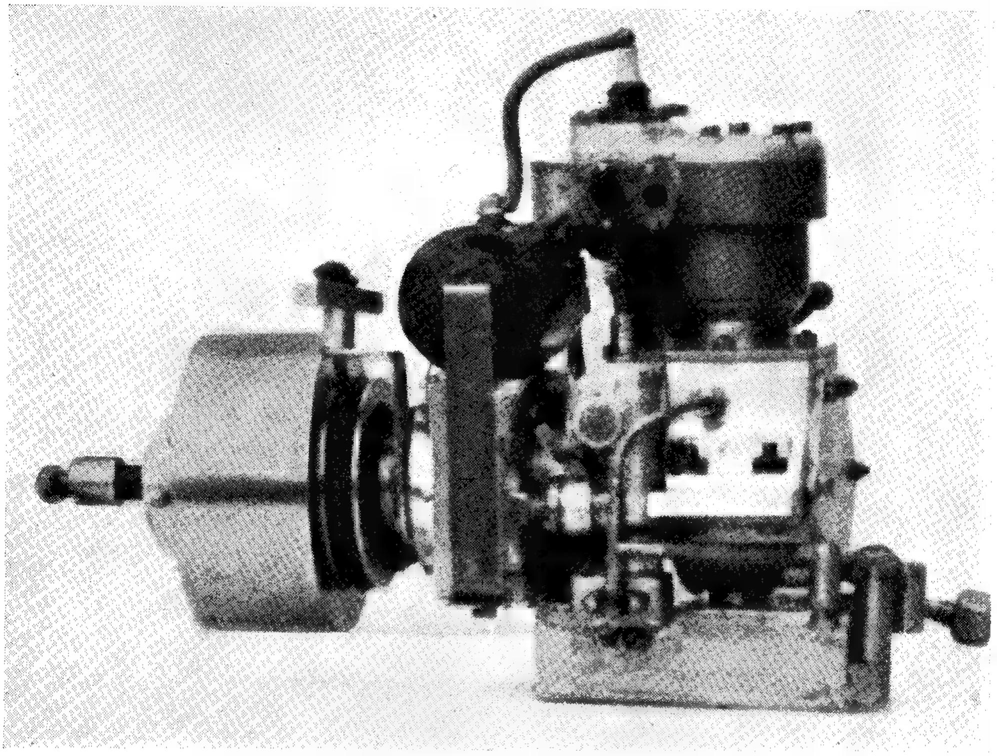
The cylinder, $\frac{3}{4}$-in. bore and stroke, is made up of a chrome-steel wet liner, having ■ bronze jacket

shrunk on, which is held in place by ■ 40 t.p.i. screwed ring at the top. This jacket also incorporates the side valves and their requisite porting.

A water passage was drilled between the ports and a slot cut around them as far ■ possible. A cover was then silver-soldered on. Flanges

The petrol pump is of the diaphragm type, having ■ diaphragm $\frac{7}{16}$ in. diameter ; the valves used are $\frac{1}{16}$ in. balls on 1/32-in. seatings. This pump feeds a chamber on the carburettor, having ■ spill pipe at the required petrol level.

The water pump, again of diaphragm type,



View showing petrol pump and oil pump assemblies

were also silver-soldered on for the carburettor and exhaust pipe, and water inlet and outlet at the same heating.

The cylinder head is of duralumin and is not water-cooled. It does not appear to get unduly hot under any running conditions.

The piston is of cast-iron fitted with two rings. The connecting-rod is of duralumin, milled to " I " section, bushed at the little-end and fitted with ■ $\frac{3}{16}$ in. bore ball-race at the big-end.

The 7 : 1 reduction gear, previously mentioned, drives ■ vertical shaft, having ■ gear-type oil-pump at the bottom. It is also fitted with a three-lobe cam of 1/32 in. lift half-way down to operate the petrol pump.

The oil pump uses $\frac{1}{4}$ in. diameter by $\frac{1}{4}$ in. long gears. It takes oil from the built-up sump beneath the crankcase and delivers it via ■ pressure relief-valve, to ■ fine jet, No. 70, which sprays the oil on to the connecting-rod and big-end. The remainder of the engine is splash lubricated. A centrifugal oil thrower is fitted in front of the magneto magnet.

uses $\frac{7}{8}$ in. diameter diaphragm and $\frac{3}{16}$-in. bronze ball-valves.

Originally an eccentric vane-type of pump was used but trouble occurred with this due to leakage at the shaft, and the pump was too small to fit ■ gland. Only a trickle of the cold pond water is needed for cooling.

The contact-breaker is fitted with ■ 90-deg. rocker arm and is enclosed as far as possible in ■ celluloid box.

Three carburettors have been tried with this engine, as I wished to obtain reasonable compensation over the speed range. The first was similar to the one designed for the " 1831 " engine, but of reduced size. This gave trouble with sticking of the air slide.

The next one was of the Atom " R " type, reduced to 5/32-in. choke tube ; but results were worse, and difficulty was experienced in fitting ■ butterfly throttle to close sufficiently tightly.

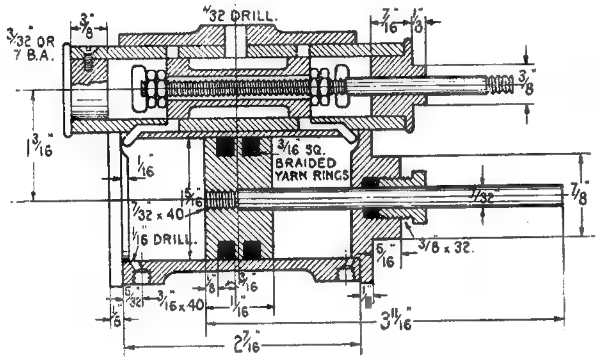
The present type, which is fairly satisfactory, if not of the highest efficiency, is of the mixing

(*Continued on page* 749)

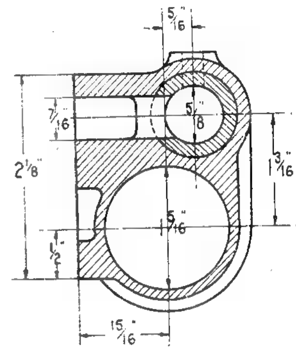
"PAMELA" by "L.B.S.C."

A $3\frac{1}{2}$-in. Gauge Rebuild of a Southern Pacific

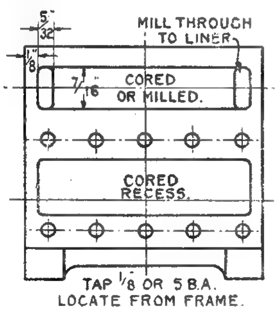
THE cylinders for this engine are very similar to those specified for *Doris*, for reasons mentioned in the opening instalment. They are correct piston-valve type, with big ports and free exhaust; much easier to make than the slide-valve pattern, with its array of steam-chest studs, and extra joint gaskets; and no valve-spindle glands to blow, and cause an insidious loss of steam. You can't see "redhot" steam blowing from a spindle gland, and can't hear it above the noise of the engine and the clatter of the car wheels when running; and I have come across several cases where the mere tightening, or repacking, of spindle glands has made all the difference in the world to the performance and efficiency of a slide-valve engine. As *Pamela* is supposed to be a Curly rebuild of the full-size job (a ghost C.M.E. on the S.R. as well as a ghost driver?) and therefore the coupled wheels are already arranged for the 24 in. stroke as originally designed by the gentleman now in Patland, we shall need cylinders somewhere around the equivalent of 21 in. bore, to get an equivalent tractive effort; so I have arranged matters in accordance. *Pamela's* cylinders will be $1\frac{5}{16}$ in. bore and $1\frac{1}{2}$ in. stroke, with $\frac{5}{8}$-in. piston valves.



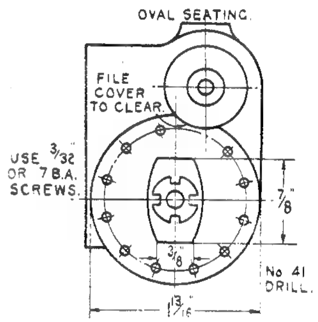
Section of cylinder



Cross section through exhaust port



Bolting face of cylinder



Back end of R.H. cylinder

How to Machine the Castings

The machining and fitting are pretty much the same as described for *Doris*, so there won't be any need to inflict a long, boring, interminable rigmarole on our good friends who are building the engine. The castings require all the boring, not the builder! Here is a brief resumé of the job, for the benefit of those good folk who didn't read the *Doris* notes; also, it may save those who did, from searching out their back numbers. Check off the core-holes for main and steam-chest bores in the casting; if they are reasonably true with the bolting face, there is no need to

mark off the cylinder ends. If they are much "out," proceed as given for *Tich*, smoothing off one end with a file, covering with marking-out fluid, and marking off the location of the two bores with wood plugs in the core-holes. Smooth off the bolting face with a file, and mount the casting on an angle-plate attached to the lathe faceplate. Set it with the bolting face down, and secure the casting by means of a bar across its back, with a bolt at each end. A try-square will soon show if it is square with the faceplate. If, like myself, you are the lucky owner of a Keats angle-plate, all you have to do is merely drop the casting into the vee, tighten the clamp, and Bob's your uncle. In either case, leave a wee bit overhanging the edge, so that the flange can be faced off.

Adjust the angle-plate on the faceplate until the main core hole, or the marked circle, as the case may be, runs truly; then tighten the bolts. When locating by the core hole, I run the tail-stock up, with the centre point in the barrel, and that does the locating a jolly sight quicker than I can write these words. When setting to a marked-out circle, the needle of a scribing-block standing on the lathe bed, is very nearly as speedy. I have a home-made scribing-block with a pillar nearly as tall as the G.W.R. skyline signal that Mr. Maskelyne wrote about some time ago, and it surely comes in handy! If locating by core holes, face off the cylinder end with a round-nose tool before boring; if the end is marked, bore first, or you'll wipe out marking No. 2 with the facing tool. Bore with an ordinary tool in the slide rest, and take a good hefty cut on the first traverse, to clean out the hard skin. Incidentally, most boring tools are too flimsy; they should be as thick as the job will allow. I have a couple of real thunder-and-lightning "Rennite" tipped boring tools made by the Rennie Tools Co., of Manchester; and used on my Milnes lathe with the self-act operating, they go through a tough bronze cylinder casting like a train going through a tunnel, and just about as noisy.

Don't Worry About a Big Reamer!

I don't imagine that many *Pamela* builders will own a $1\frac{5}{16}$-in. reamer, but that won't matter a bean; just work the old wheeze of taking the final couple of traverses through, without moving the cross slide, and the result should be practically as good as reaming. I usually finish big cylinders with a boring tool (*Jeanie Deans's* "dustbin," for example) and never have any trouble. When you have finished the main bore, ditto repeato on the steam-chest bore, merely shifting the angle-plate bodily on the faceplate to reset; don't on any account slack off the casting, or the bores won't be parallel. Take a final skim off the flange before dismounting the cylinder. Face the other end with the cylinder mounted on a mandrel; you'd better put it between centres, if the lathe is of the usual light home-workshop variety. Then up-end the casting on the angle-plate, with a long bolt through the main bore, plus a big washer of soft metal, to avoid spoiling the flange; face off the bolting face to dimension given.

There are no passage-ways to drill on these cylinders—thank goodness, says you—merely drill two or three holes close to the lip of the main bore, into the steam-chest bore, and file a little slot with a rat-tail file, as shown in the perspective sketch No need for "mike" measurements; just make the slot about $\frac{1}{2}$ in. long, and slope it to meet the filed-away part of the steam-chest liner. The combination will pass all the steam needed for efficient working, without wasting a puff. I do jobs like this with a small Woodruff key cutter in my vertical miller, in about two wags of a dog's tail. Writing, drawing, and correspondence takes such a time that if I didn't get a move on, when in my workshop, I'd never get any locomotive work done at all.

Covers and Liners

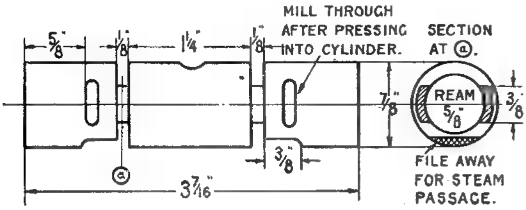
The front cylinder cover is the usual plain disc with a $\frac{1}{16}$ in. register to fit in the cylinder bore; a simple turning job any kiddy could do. The back one has the usual screwed gland, and is turned up as fully described for *Tich*, taking care to get the register an exact fit in the bore. The guide-bar seats on the gland boss can be cut with an end-mill, if you haven't any other means. The cover should be secured by a bolt through the piston-rod hole, to a bit of steel or iron bar held in the slide rest, packed up to correct height, and traversed across an end-mill, not less than $\frac{3}{8}$ in. diameter, held in three-jaw. When setting up for cutting the second seating, be careful to have the first one exactly at right-angles to the lathe bed; set it with the blade of a try-square against the first seating, and the stock against the slide rest. The gland is turned up from a piece of $\frac{1}{2}$-in. drawn bronze rod held in three-jaw, and is slotted for operation by C-spanner as shown, though a hexagon head may, of course, be substituted if you so desire.

Bore and ream the liner casting, with the latter held in the three-jaw. After facing the ends to a shade over length, mount between centres, and turn the outside to a press fit in the liner bore. For beginners' especial benefit I'll repeat that the veriest Billy Muggins who ever broke a parting-tool or skinned his knuckles on the chuck jaws, can turn the liner to a press fit if he turns the whole length until it just *won't* enter the steam-chest bore (says Pat) then turns $\frac{1}{8}$ in. length until it just will, then turns the cross-slide handle back half a turn, and advances it again "very-nearly-but-not-quite" to the same place; within half a division, if the cross-slide screw has a "mike" collar on it. If the whole length of the liner is then turned, with the tool at this setting, the liner will be a press fit all right, and without any help from the elaborate instruments found necessary by the "witch-doctor" fraternity.

The $\frac{1}{8}$-in. grooves are formed with a parting-tool, with the liner still between centres; make them a bare $\frac{1}{16}$ in. deep, then file or mill into the bores, at top and bottom of the grooves, leaving a $\frac{3}{8}$-in. bridge at each side. File away the bits at the bottom, to form the steamways to cylinder, and they are ready for assembly.

Drill eleven No. 41 holes in each cover as shown, for the fixing screws, leaving a blank space where No. 12 would normally be located, as shown in the end view of the right-hand cylinder. This shows how to arrange them to miss the tapped hole for the drain cock in the bottom of each flange. Then use the covers to locate the tapped holes

in the flanges for the screws, as I have described fully, goodness only knows how many times already. To make certain that the guide-bar seatings are at right-angles to the bolting face, lay the cylinder, bolting face down, on the lathe bed or any similar flat surface, set the cover "by eye," put your try-square alongside it, and with stock of same resting on the flat surface, set one of the guide-bar seatings to the blade.



Steam-chest liner

Put each cover temporarily in place, with a couple of screws to hold it; they will, of course, overlap the steam-chest bores a little. Poke your scriber down each bore, and scratch along the projecting bit, on the contact side of each cover. Remove covers, and file away the segment indicated by the marking; the cylinder covers will then clear the ends of the liner when same is pressed home. The latter job can then be done, either by using the vice as a squeezer, or if the jaws won't open wide enough, using a long bolt, same as I described just recently for the 5-in. gauge *Doris* cylinders. Be careful to line up the filed-away flats on the liner, with the slots at the ends of the bores. After the squeezing process, put the $\frac{5}{8}$-in. reamer through the liners again, in case they have become distorted or closed in.

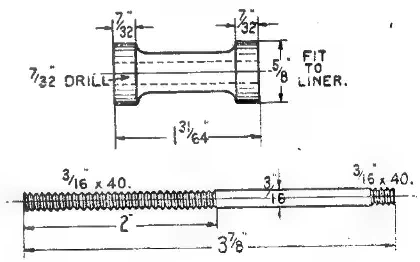
For the steam entry, a 7/32-in. hole is drilled through the middle of the flat seating over the steam-chest, right into the liner; the "entrances to the way out" are milled, or drilled and filed, from the extreme ends of the exhaust cavity in the bolting face, clean into the liner. One of our approved advertisers ("Wilwau") makes a speciality of coring the steam and exhaust ways in the casting. Old George Kennion (still going strong, at time of writing) at one time specialised in piston-valve cylinders of his own design, with cored passages. The drain-cock holes are drilled "blind," 5/32 in., and tapped $\frac{3}{16}$ in. × 40; after which, drill a $\frac{1}{16}$ in. hole from the blind end, on the slant, into the cylinder bore, so that it emerges as close to the register on the cover as possible. Put the reamer through the liner again, to remove any burring, and scrape off anything left around the drain holes in the main bore.

Pistons and Valves

The piston rods are made from 7/32-in. ground rustless steel, and the finished length is $3\frac{11}{16}$ in.; put $\frac{5}{16}$ in. of 7/32 in. × 40 thread on one end. The best stuff for the pistons would be the alloy used for automobile engine pistons; if you could get a couple of discarded ones, melt them down and cast a stick $1\frac{3}{8}$ in. diameter, you would be in clover. Maybe our approved advertisers will oblige. The amount of wear of the pistons in the engine of my gasoline cart is negligible, and the millions of times they have been up and down the cylinders in the course of over 13 years, far outnumbers the strokes made by the pistons of a little locomotive during the whole of its lifetime, apart from the difference in length of stroke. If this alloy is not obtainable, use drawn bronze or gunmetal. Turn the blanks to 1/64 in. over size, with the metal held in the three-jaw; face, centre, drill $\frac{3}{16}$ in., turn two grooves $\frac{3}{16}$ in. wide and deep, for the packing rings, and part off. Rechuck, open out centre hole to $\frac{3}{8}$ in. depth with No. 3 drill, tap the rest 7/32 in. × 40, and enter the piston-rod by means of the tailstock chuck, as I have often detailed out before. Finally, turn the piston to an exact sliding fit, with the rod held either in a collet, or in a split bush in the three-jaw; ancient history to regular followers of these notes.

If the reamer used for the liner has cut dead to size, the piston-valves can be made from a piece of $\frac{5}{8}$ in. ground rustless steel, and will need no turning. If they do have to be turned, face the end of the rod, centre and drill for the spindle, then bring up the tailstock centre to support the job whilst turning away the unwanted metal between the bobbins. Make a groove with the parting-tool at a bare $1\frac{1}{2}$ in. from the end; turn bobbins to exact dia, same as pistons, finish parting off, reverse in chuck, and face off the parted end to dead length. The spindle is merely a piece of $\frac{3}{16}$-in. rustless steel, screwed as shown, and ordinary commercial brass locknuts can be used. The front end of the liner is closed by a simple shouldered plug turned from 1 in. diameter bronze or gunmetal rod, or from a casting; the back is similar, except that it has a $\frac{3}{8}$-in. boss on it, and is drilled and reamed $\frac{3}{16}$ in. for the valve spindle. Both plugs should be a tight push-fit in the ends of the liner, and a 3/32-in. or 7-B.A. set-screw, should be quite sufficient to prevent them coming out of their own free will and accord. Two, or even three screws may be put into each, if desired.

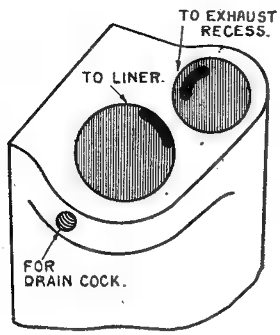
The cylinders are assembled as shown in the illustrations. The pistons are packed with two



Piston-valve and spindle

rings of $\frac{3}{16}$ in. square braided graphited yarn; the ends are cut off at an angle, like the joint in an ordinary metal piston-ring. I find this much superior to packing wound around in one long strand. The grooves should be turned deep enough to allow the rings to enter the bores with very little prodding; the elasticity of the material will ensure perfect steamtightness with the

absolute minimum of friction, and the graphite content will prevent any damage to the cylinder bores in the event of temporary failure of the oil supply. Ratchets miss a tooth sometimes at high speed, especially if thick black treacly oil is allowed to get on them; and grit or other foreign matter under a clack-valve is not entirely unknown, so we "insure against eventualities." Oiled brown



How to cut steam and exhaust ways

paper, or 1/64-in. Hallite or similar jointing, will be O.K. for the cover joints, and a few strands of ordinary graphited yarn for the piston-rod gland. Next stage, guide-bars, crossheads, and connecting-rods; then we can erect the whole lot together.

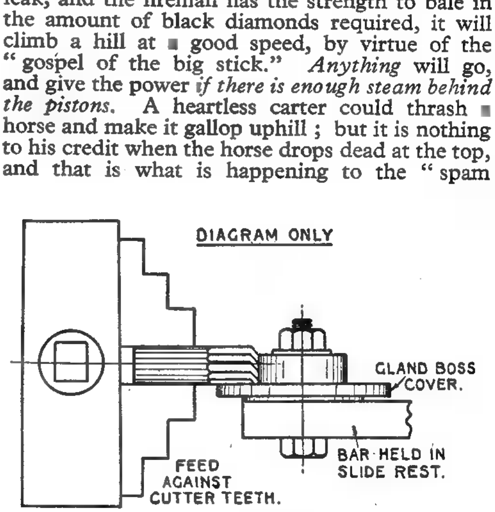
History Repeats Itself

A fair amount of correspondence has come to hand since *Pamela* made her bow, about the full-sized engines; so maybe if I deal with it right here, it will save readers' time, and my own. A few "patriotic" Southernites praise the spam cans, and say they can climb hills, if nothing else; whilst others are inclined to favour them on the grounds of "originality." Regular readers may recall my little dissertation when they first appeared; I said, time proves all things, and if they proved themselves worthy, I would be the first to give them credit. Well, they haven't; far from it. Let's do a little analysis, and rake up a few facts.

In the old days of small locomotive building, before *Ayesha* "astonished the natives" at the Caxton Hall, it was accepted as "gospel," that the only way to ensure success on any engine, was to put the biggest possible boiler on the frames. At the present moment I have an old copy of *The Model Railway News*, in which is described and illustrated, the "last word" in gauge "1" 4-6-0's. It was built commercially, and had a boiler 3 in. diameter, extending from buffer beam to drag beam (compare that with the "scale" boiler of the "wee *Dot* like *Doris*") and this was deemed essential for hauling a few tin coaches on a non-stop run. It looked a real top-heavy freak. This idea arose because folk blindly accepted the "rules" laid down by designers who only put their engines on paper and never on the track. The idea of expansive working in little cylinders was "all rubbish," and so on and so forth. Consequently, the "works" of engines built to these ideas were beautiful examples of inefficiency—but they could be made to go, provided that the boiler could supply the steam, either by virtue of its size, or by forcing it in one way or another; usually both, "with knobs on," as the kiddies would say.

The "spam cans" are a full-sized example of a similar "gospel." They have an inefficient arrangement of cylinders and motion which mops up an exorbitant amount of steam; *and the only thing that keeps them going is the size of the boiler.* Even when new, and specially titivated up, they use much more coal, oil, and water than a normal engine would do on the same work; they came out "bottom dogs" in the locomotive exchange trials. When a little worn, they break the drivers' hearts and the firemen's backs; whilst the maintenance staff's ideas about them would set this paper alight if I attempted to chronicle it. At one of the Southern "get-together" meetings, a driver got up and said that if British Railways contemplated making the "spam cans" a standard type, they had better start building repair shops at every station in the country!

If the boiler of a "spam can" is clean, doesn't leak, and the fireman has the strength to bale in the amount of black diamonds required, it will climb a hill at a good speed, by virtue of the "gospel of the big stick." *Anything* will go, and give the power *if there is enough steam behind the pistons.* A heartless carter could thrash a horse and make it gallop uphill; but it is nothing to his credit when the horse drops dead at the top, and that is what is happening to the "spam



How to end-mill guide bar seats on cylinder cover

cans." In my humble opinion, the designer cannot claim any credit even for this part of the business, because the boilers fitted to the "spam cans" are American-type boilers complete with steel firebox, combustion-chamber, thermic syphon, and butterfly firehole door. You have only to look through the pages of the *Locomotive Cyclopedia*, to see plenty of drawings of similar boilers, which if made as therein specified, and properly worked, give complete satisfaction. The way the "spam can" boilers have to be worked, to make the engines do anything at all, is reflected in the maintenance they are requiring, which is far and away above anything else on any type of engine. The American boilers have a

proper smokebox, not ■ thimble mounted on the end.

As to the cylinders and motion, the idea that the double chain drive neutralises the rise and fall of the axle, is completely cancelled out by the lost motion as soon as the chains stretch—a matter of days—and the complication of the inaccessible boxed-in valve-gear. The way the valve is driven, from the centre, *via* a double-armed rocker, is not a good feature, and a long succession of bent and broken rockers have caused endless failures. A flexible arrangement of steam pipes had to be provided, to prevent broken pipes and flanges. There are umpteen other faults, but I need not dilate on them here. Several specials went past here, hauled by " spam cans " during the Easter holiday traffic, and of the whole lot, only one had six beats ; by her appearance she had just been done up. One of the others had three only ; it was ■ scream to hear her—three puffs, three pauses, three more puffs, three pauses, and ditto repeato until she was out of hearing. She wasn't doing more than 20 m.p.h. up the 1 in 264, with ten on. It was a happy relief to see and hear the relief boat train go past, with an old Brighton Atlantic pulling it, as easily as you please ; twelve coaches and a van, getting well hold of the load, with every beat sharp and distinct, perfectly even, and a white feather at the safety valves. But I give credit where due ; the " Milly Amp " engine, hauling what the kiddies call the " Gamage express," on account of the new colours, slipped by almost without sound, and certainly without effort ! The steam locomotive is, and will remain, my all-in-all, but I have a sneaking regard for Milly ; if it were not for her tireless and willing help in my workshop, I should not, at my time of life, be able to do any locomotive-building.

I happen to know a good deal more than certain readers of this journal might imagine, about " spam can " construction, maintenance, and running, and will say this—that with divided drive, three separate sets of proper valve-gear, ■ big smokebox, and strengthening up of certain parts, they might have made a far different record. It wasn't your humble servant who nicknamed them " spam cans " ; the shape of the tin-pot casing did that ! It need never have been put on, had the engines been built as above. It will probably be taken off when the engines are rebuilt ; it doesn't need a Sherlock Holmes to deduce that, with the insistent call for economy, they will not be allowed to eat coal and oil, keep the whole repair staff fully employed, and upset the schedules by failures on the road, for much longer. But, curiously enough, the fact that they can be " flogged " uphill (at ■ cost !) has verified a contention that I have proved in small size, and advocated for full size, viz, that plenty of cylinder power does the trick. The 280 lb. boiler pressure boosts up the tractive effort to an extent that can slip the wheels like a buzz-saw when starting ; but if the pressure (and consequently the cylinder power) doesn't fall off, *the tractive effort is still sustained at high speed, and is naturally utilised*, which explains why the " spam cans " climb, if the boiler is in good trim and the fireman can " keep her hot." Another vindication is the behaviour of the L.M.S. Pacifics ; they slip badly when starting, but all students of locomotive history will recall the magnificent performance of *Duchess of Abercorn* with ■ load of over 600 tons up Shap. The cylinder power does it, provided the boiler can supply the steam. Neither the " spam cans " nor the " Duchesses " would slip at starting, if they had ■ regulator that really was ■ regulator, instead of " all-or-nothing."

Several readers also mentioned the so-called *Leader*. About the best thing to do with that, would be to scrap the useless boiler, cylinders, and motion, and turn it over to Milly Amp. With half-a-dozen of Milly's motors in it, it would be ■ very powerful and useful addition to the Southern Region electric stock ; but it might need some alteration to the bogies. 'Nuff sed !

A 6-c.c. I.C. Engine for Boat Propulsion

(*Continued from page* 744)

valve type, using a barrel throttle. The mixing valve itself is of $\frac{5}{16}$ in. diameter and has an adjustable lift which is set to about 3/64 in. A light spring holds it on its seat. A speed range of about 300-6,000 r.p.m. has been attained with this carburettor without any jet adjustment being needed.

A ratchet starter is fitted into one side of ■ good heavy flywheel and a plate clutch in the other.

High performance was sacrificed to some extent for the sake of flexibility and quietness in this engine, to which an effective silencer has been fitted. Apart from the carburettor and water pump teething troubles, it has performed very well and usually starts in one or two pulls.

The magneto gives a very effective spark and would spark down the outside of ■ Lodge $\frac{1}{4}$-in. plug whilst running. It was built to the " Atomag " design in its essential dimensions.

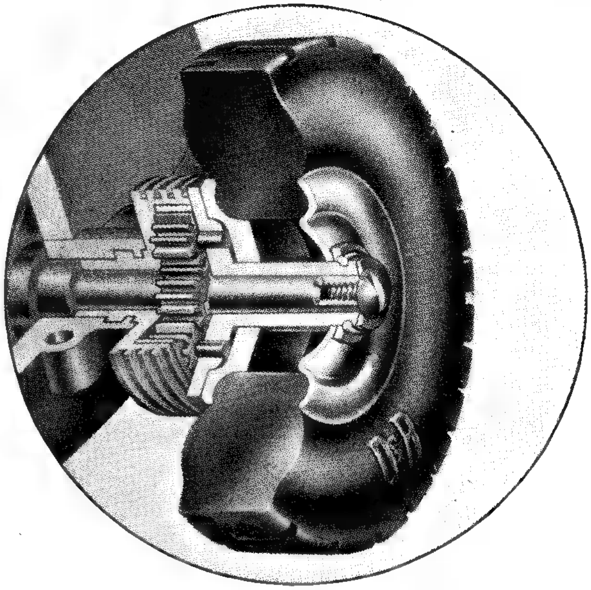
The whole unit can be removed by the disconnection of four pipes, the propeller shaft and four engine bolts and only ■ small amount of the superstructure.

The engine has done ■ season's running in a 3-ft. 6-in. hull and propels it nicely at about 5-6 m.p.h.

In conclusion, I should say that, the layout in the hull is quite neat and compact and there is enough room to fit radio control apparatus, which I hope to do shortly.

The Ohlsson and Rice Midget Car

by Ron Warring



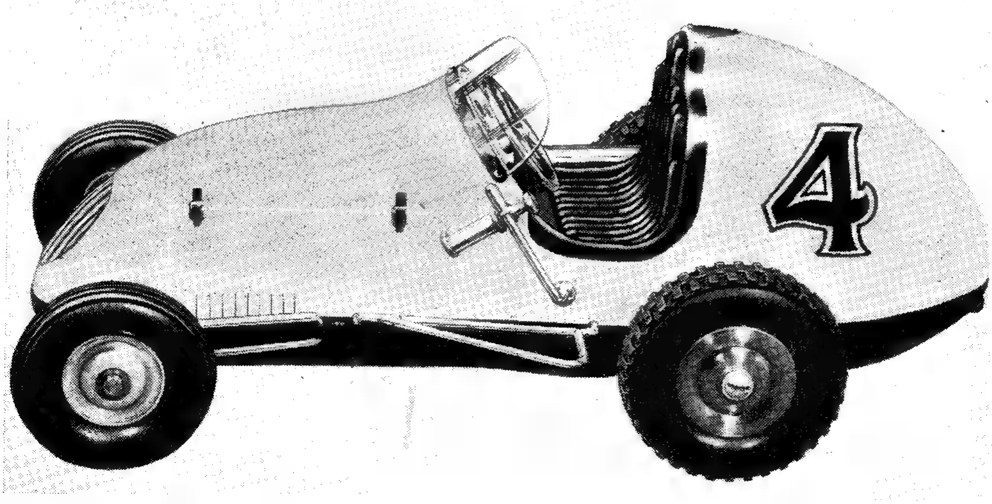
The completely enclosed planetary gear drive unit of the Ohlsson and Rice model midget car—automatically lubricated through engine attached by special crankshaft

FOLLOWING the lead given by the Duromatic Company, manufacturers of the McCoy range of motors and race cars, the latest Ohlsson and Rice production is a scale model of the midget racer that consistently held No. 1 position at the famous Gilmore racing oval in Los Angeles.

Ohlsson and Rice, undoubtedly the world's largest manufacturers of miniature aero-motors, have hitherto produced motors and accessories intended solely for model aircraft work. So popular have they been in this sphere that, until fairly recently, they have had a backlog of orders. Now, it seems, they have been forced to look to other lines to maintain their volume of sales, those of model aircraft having dropped considerably over the last 18 months, with well over half the total interest being centred in the very small ½-A class glow-plug motors.

Ohlsson and Rice, therefore, have entered the model car field, via model aircraft, so to speak. Dick McCoy, on the other hand, designer of the original McCoy motors, is a race car enthusiast. In fact, almost all the racing type miniature aero-motors are direct descendants of motors originally produced for race car work.

The new Ohlsson car, which as yet remains unnamed, is powered by a 5 c.c. (0.29 cu. in.) glow-plug motor which, the makers claim,

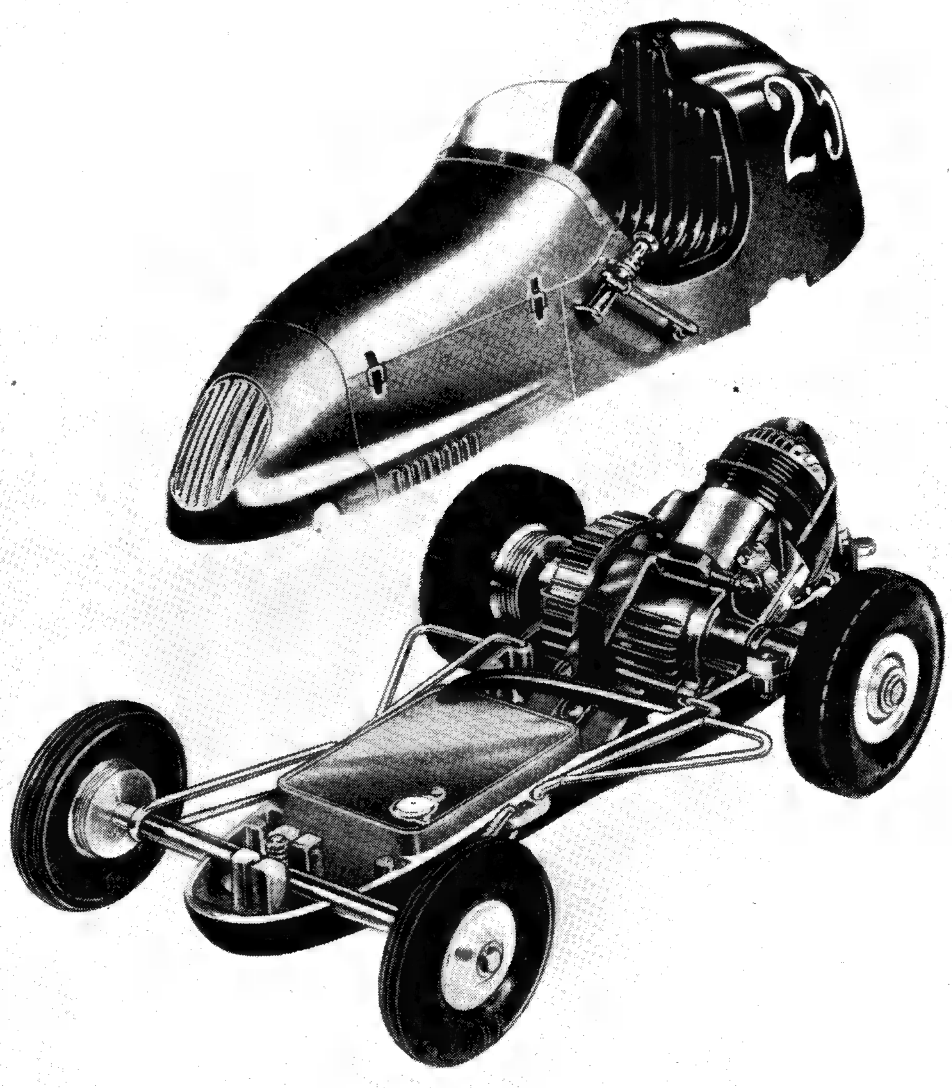


Showing the amount of scale-detailed accessories

is not a converted aero-motor, but a completely new design. From a study of the photographs, however, it would appear that the same castings have been utilised as far as possible, with the crankcase unit redesigned to accommodate the necessary drive and gearing.

Drive is through a centrifugal clutch, so that the car can accelerate away from a standing start, the actual drive being of the planetary-gear type with a 3 : 1 ratio—see cut-away photograph. The crankshaft features dual counterweights and roller bearings.

The pan is cast, with the tank formed integral with it. The motor is mounted aft of the drive wheels at an angle of some 40 degrees so that it is completely enclosed under the body in the compartment behind the driver's seat. This body is attached to the chassis by a spring clip which provides instant accessibility, yet positive locking. Cooling air for the motor is presumably inducted through the radiator grille and guided back under the seat to the motor unit. For tank filling and motor adjustment, the body must be detached.



The Ohlsson and Rice model midget car with body removed, showing installation of special 0.29 *cu. in. engine, and built-in petrol tank*

Novices' Corner

The Lathe Knife-Tool

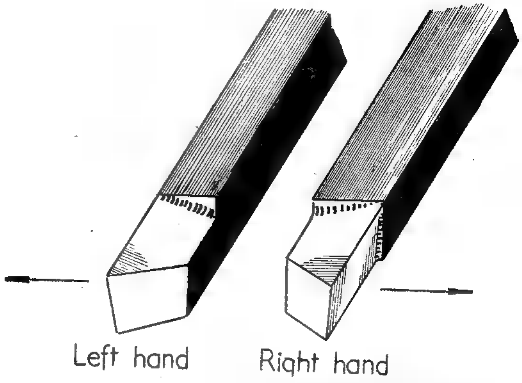


Fig. 1. Left- and right-hand knife-tools

THE beginner at lathe work may well be puzzled when he sees in catalogues, or at the tool-merchant, sets of lathe tools of twelve or even more varieties, for at first he will hardly be familiar with the purposes for which the individual tools are used.

However, most straightforward turning operations can quite well be carried out with a single knife-tool of simple design, although for boring, screw-threading and parting-off, tools of special shape will be needed.

The knife or knifing-tool is, perhaps, the most useful tool for general turning, that is to say it is well-adapted for reducing the diameter of the work to any required size, and in addition it can be used for facing the ends of the work or for forming shoulders. When starting lathe work, it is a good plan to try to master one type of tool, thus learning exactly what the tool will do: what depth of cut it will take; what rate of feed is best; and what depth of final cut will impart the best finish to the work; in addition, the method of sharpening the tool correctly must be learnt if good results are to be obtained.

Clearly, all this information can be gained only by practical experience, and if the trial work is methodically carried out, it should not be difficult to trace the cause of failure when things go wrong.

A pair of typical knife-tools are illustrated in Fig. 1; the right-hand tool is used when cutting towards the headstock, as in most turning operations, and its left-hand counterpart is designed to cut towards the tailstock, although this is a turning operation that is seldom needed.

Knife-tools can, of course, be bought already ground to shape and sharpened for use, but sooner or later the cutting edges will have to be resharpened by grinding. A ready-made tool will, moreover, serve as a pattern, should it be decided to make a similar tool from a length of tool-steel. Short lengths of heat-treated, high-speed tool-steel can be obtained from any tool-merchant, and those of the Eclipse brand have their ends obliquely ground, so that but little additional grinding is required to make a serviceable knife-tool. Before going further, it will be as well to describe in detail the formation of the cutting edges of a knife-tool, and also to explain, with the aid of the drawings in Fig. 2, the terms used to denote the various angles formed at the tool's tip.

In the first place, to enable the cutting edge at the side of the tool to bite into the work, a clearance angle must be formed behind this edge. The ordinary wood chisel provides an example of this, for if the bevelled end of the chisel is held flat against the work, the tool will not cut, but, as soon as the handle is raised so as to form a clearance angle between the blade and the wood, the tool will cut freely.

The exact value of this side clearance angle in the knife-tool is not important for all ordinary turning, but should be between 5 deg. and 10 deg. to ensure that there is sufficient clearance

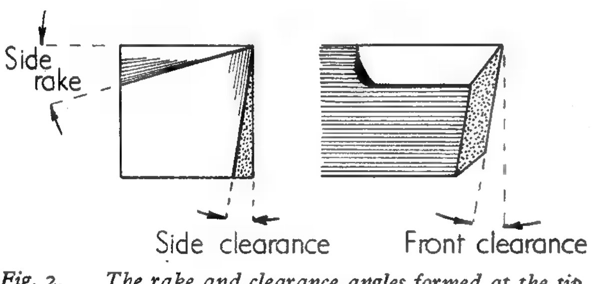


Fig. 2. The rake and clearance angles formed at the tip of the knife-tool

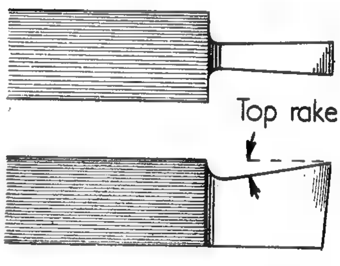


Fig. 3. Showing how top rake is formed on a parting-tool

without needlessly weakening the tip of the tool.

It will be seen that, in addition to the side clearance, a front clearance angle is formed where the front cutting edge of the tool meets the work, otherwise the tip of the tool would merely rub against the work, and would be unable to cut.

To return to the wood chisel; if this tool is held nearly upright, and almost at right-angles to the work surface, it will only scrape the work when pushed forwards, but, if the handle is now

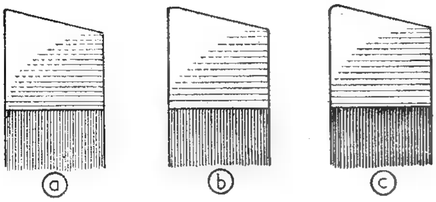


Fig. 4. Forms of the tool's front cutting edge

depressed, the blade will cut more and more freely as the angle between the chisel and the wood is reduced. This angle is termed the rake angle, but as the angle at which a lathe tool is mounted in the toolpost usually remains fixed, the rake angle is formed on the tip of the tool itself, as depicted in Fig. 2. As the knife-tool's normal direction of cut is along the work towards the headstock, this rake angle is formed across the tip of the tool and is then known as side rake. Thus, the two angles of side clearance and side rake together form the side cutting edge of the tool. The value of the side rake angle in a knife-tool largely determines its capacity to cut freely, for a large side rake will give a slicing cut; but this must not be overdone, or the cutting edge will be weakened, and become liable to fracture.

For cutting steel, a side rake angle of from 15 deg. to 25 deg. may be employed, but the harder the steel the less should be the rake angle. Free-cutting, mild-steel is best turned with the maximum amount of rake. Some tools have a rake angle sloping backwards from the tip towards the shank; this is called front or top rake, and an example of this is shown in the parting-tool illustrated in Fig. 3.

The shape of the front edge of the knife-tool is of some importance, for if the length of this edge in contact with the work is too great, chatter may be set up, particularly where the work is not supported by the tailstock centre, or the lathe itself lacks rigidity. On the other hand, should the area of contact be too small, there will be a tendency for the tool to cut a fine spiral groove on the work and the finish will be poor; this may come about when the tip of the tool is ground to a sharp point, as shown in Fig. 4a. To give a good finish to the work, a small flat may be formed on the front cutting edge of the tool, as illustrated in Fig. 4b, but to avoid chatter this flat must be kept small. Another way of forming the tool to obtain a good finish on the work is to round the tip of the tool, as shown in Fig. 4c.

It will be clear that, when taking a deep cut along the work, the extent of the front cutting edge in contact with the material may be excessive if the tool's tip is not formed so as to counteract this. A new term, the relief angle, must therefore be introduced to complete the description of the front cutting edge of the tool. This angle, which is represented in Fig. 5, should not be so small as to cause chatter, nor so great as to weaken the point of the tool; a relief angle of some 15 deg. will be found suitable for ordinary turning operations.

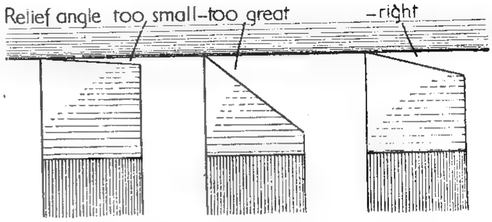


Fig. 5. Showing the effect of varying the relief angle

So far, only the action of the tool when cutting along the work has been considered, but a knife-tool of the form described will serve well for facing the ends of work or for turning and facing shoulders. For these operations the tool should be set as in Fig. 6 so that only the tip of the tool, and not the whole side face, comes into contact with the work. As there is but little tendency for chatter to arise during facing operations, there is usually no need to maintain a relief angle of 15 deg. between the work and the side

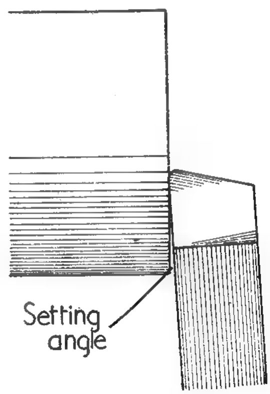


Fig. 6. Setting the knife-tool for facing

face of the tool. A tool with a rounded tip will give a good finish when used for facing, but a tool of this form will not, of course, face to the full depth of a shoulder, as it will leave a rounded corner which will, however, add to the strength of the part in this situation.

Knife-tools should be set in the toolpost at centre height, and this is particularly important when machining a taper on the work. The setting can be readily checked by taking a facing cut across the end of the work, for a tool set either above or below centre will leave a central

(*Continued on page* 757)

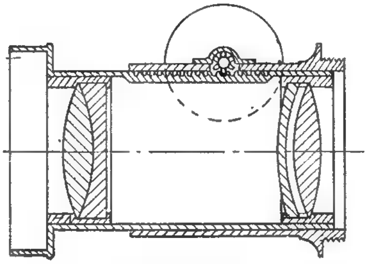
*Miniature Slide and Strip Projectors

by "Kinemette"

BEFORE going into details regarding the lenses recommended as suitable for this projector, one or two further technical points may be dealt with. The term "aperture" frequently used in connection with camera and projector objective refers to the effective opening at the centre of the lens system, expressed in its fractional proportion to the focal length. Thus the figure F/3 indicates that the aperture is equal to 1/3 of the focal length; in a lens of 3 in. focal length, this would mean that the opening in the diaphragm is 1 in., provided that it is in the exact optical centre, which is strictly true only in the case of a symmetrical lens.

Stops or diaphragms are used to limit the effective aperture of a lens, for the purpose of cutting off the marginal rays (which are most likely to affect sharp definition) thereby improving flatness of field and depth of focus, the latter term meaning the amount of tolerance in the focusing adjustment, over which a reasonably sharp image can be produced. The wider the aperture of the lens, the less the depth of focus, and the more critical the focusing adjustment necessary. In made-up or adapted lenses, it is advisable to make some experiments with stops, and the handiest form of stop is a short sleeve or ferrule to slip inside the lens tube, with a stepped rebate in the bore, into which a thin metal disc is made a snap fit. Various sizes and positions of the stop can be tried, and when the best results are obtained, both the diaphragm and the sleeve can be fixed by sweating. All internal parts of the optical system should be dead-blacked to cut down reflection.

High-class objectives have the lens components fitted in screwed cells, but for practical purposes, the simple method of retaining the lens with a circlip gives equally good results.



Petzval portrait or projection objective, in rack focusing mount

Condensers

Some notes have already been made on the type of condenser recommended, and it may be mentioned that whether a complete mounted condenser or separate unmounted lenses are obtained, the nominal focal length of the complete unit should be about 2 in., which will be suitable for use in conjunction with objectives of 3 to 3½ in. focal length, within the latitude of normal adjustment of relative positions of illuminant and optical units. If suitable plano-convex condenser lenses are not readily obtainable, it may be noted that the old type of illuminating condenser used by microscopists, or a very short-focus magnifying lens about 1½ in. diameter or even a good quality "bull's-eye" lens from a large police torch, may be found suitable. High finish and accuracy of the lenses, though desirable for illuminating efficiency, are not absolutely necessary; but they must be free from obtrusive irregularities, scratches, or bubbles.

It may be mentioned that in some of the older forms of optical lanterns, "water condensers," comprising water-filled cells having curved watch-glasses on one or both sides, were sometimes used, and in some cases water was circulated through the cell to absorb the heat rays emitted from powerful oxy-hydrogen lime jets or arc lamps. The use of spherical or lenticular section glass flask for this purpose is not unknown, and it has been recommended quite recently in a published design for an amateur-constructed projector. But apart from the inconvenience of having to use water in the condenser cell, it would probably be found far more difficult to obtain a flask which would act as a condenser of appropriate focal length than to find a suitable inexpensive lens.

In a cool-working projector such as described here, there is a possibility that plastic lenses would be quite suitable for use as a condenser. The clear transparent plastic materials such as Perspex or Catalin have the advantage that they are easily machined and polished, so that the amateur can not only make his own lenses, but also modify them experimentally to obtain the highest possible efficiency. As the refractive and dispensive indices of these materials vary, and in all cases differ from glass, it is impossible at present to give any authoritative data on the design of the lenses, but some experiments have been made in this direction, and appear fairly promising.

Objectives

The most popular lens for this purpose is the Petzval objective, which has been used for many years on projection lanterns of every type, though strangely enough, it was not originally designed for projection, being in fact the earliest successful wide-aperture lens produced for portrait photography. When it first became popular for its intended purpose, it was surreptitiously copied by many lens makers, with greater or lesser success, and for obvious reasons, the name of the designer

*Continued from page 676, "M.E.," May 11, 1950.

was suppressed, and supplanted by coined titles, only the prefix "portrait" giving a clue to the design.

In projection lenses, the identical lens system is used, and again the quality varies widely, some lenses purporting to be of Petzval type, made by cheap Continental manufacturers, being little, if any, better than simple lens combinations which do not pretend to be "designed." Among makers of lenses for the early 35 mm. cinematographs (which are of just about the right focal length for our purpose) the name of Darlot, of Paris, has a good reputation for quality, and if one can obtain a lens of this make, about 3 to 3½ in. focal length, it may be relied upon to give excellent results. Generally speaking, however, any optician who has sufficient courage to put his name on the lens mount has at least a reputation to lose if the lens is no good. Lenses of this type usually work at an aperture of F/3.5 to F/4.5.

While the Petzval type of lens is by no means ideal from the photographic aspect, according to modern standards, having pronounced curvature of field and practically no depth of focus, these faults are not obtrusive when working as a projection lens, over a narrow angle, and to well-defined focal planes. The lens comprises two double-element combinations, as shown in the drawing, the front pair being in contact and usually cemented, and the rear pair air-spaced. In the larger sizes, the complete lens is usually fitted in a jacket with rack and pinion focusing, as shown, but the 35 mm. cine lenses usually have a plain tube mount intended to fit frictionally in ■ standardised focusing sleeve. As the lens is not symmetrical, it must be used the right way round, that is, with the air-spaced combination towards the slide, or it will not produce a clearly-defined picture. The lenses made for photographic purposes have some means of aperture adjustment by means of an iris or removable stops, but projection lenses have either a fixed stop of large diameter or none at all.

The modern "projection anastigmats" are a great improvement on the Petzval lens, and are in consequence much more expensive. Such lenses, working at apertures up to F/2, are made by several reputable optical firms, and invariably have the name engraved on the front cell, so that they are easily identified. They give critical definition when properly focused, and have a perfectly flat field over the area which they are designed to cover.

Adapting Photographic Lenses

The properties of most types of photographic lenses, although excellent from some points of view, do not show up at their best when they are used for projection. This at least applies to any such lens, other than one of the "portrait" type, which one is likely to pick up at a low price. Any good photographic lens, even the fairly simple type, is almost certain to be colour-corrected (achromatic), free from serious distortion, and capable of producing a very sharp image; but its aperture is too small in most cases for efficient projection, and does not make the best use of the available illuminating power. Modern lenses of wide aperture are very expensive, in relation to comparable projection lenses, and most of those likely to be at all suited to our present purpose have been snapped up long ago for use in photographic enlargers.

A possible exception may be found in some of the special-purpose camera lenses used in service equipment during the war. The lenses of the 16 mm. gun cameras have ■ wide enough aperture for use as ■ projector lens, and in most cases will cover ■ 35 mm. single frame fairly well (they vary in quality, having presumably been made by more than one manufacturer), but their focal length of approximately 2 in. is definitely on the short side for the type of projector under discussion.

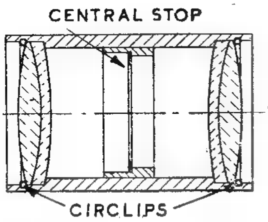
Other Available Lenses

The most promising results, in attempts to produce an objective from available components, have been obtained by using the objectives from telescopic gunsights, quite a number and variety of which are available on the surplus market. A telescope objective, it may be mentioned, is not designed to produce a projected image, but only a "virtual" or aerial image in space, which is viewed by means of an eyepiece or "field lens" focused on it. The conditions under which it works therefore differ from those of ■ projection objective, and the principles of correction are also different, but it is usually achromatic, consisting of a positive and negative lens cemented together. Such a lens will generally produce a fairly sharp image, especially if the margins are stopped off to some extent, but both curvature of field and distortion are liable to be encountered. A combination of two telescope objectives ■ short distance apart, with a stop midway between them, will form a symmetrical lens giving practically no noticeable distortion, and if the angle of coverage is fairly small, the curvature of field is not serious.

An experiment has been made with a pair of these lenses sold as magnifiers by several MODEL ENGINEER advertisers. The pair selected were of 1½ in. diameter, by about 6 in. focal length, and apparently exactly matched; they were mounted in ■ brass tube 2 in. apart, with ■ stop 1 in. diameter in the centre as shown in the drawing. This combination, of approximately 3 in. focal length, gave results only very slightly inferior to those obtained with a Petzval type lens of similar focal length produced by a reputable German optical firm. The most noticeable fault was curvature of field, which prevented very critical definition being obtained simultaneously both in the centre and at the edges, but this did not show up badly with the usual subjects, and could have been improved, at the expense of some illuminating efficiency, by reducing the size of the stop. As the original stop fitted gave an aperture of approximately F/3, it does not compare badly in light transmitting efficiency with lenses specially designed for projection, and some reduction of aperture could therefore be tolerated where critical definition is important.

Single achromatic lenses of appropriate focal length can be employed, but the aperture is generally much less than obtainable with a double lens—probably not more than F/5 or F/6—and other optical qualities are inferior. The fitting of a stop to cut down marginal rays is

usually necessary, but it introduces some distortion of the image; the usual place to fit this is in front of the lens, as shown, but the exact form of lens influences both the relation to and distance from the lens, and some experiment may be necessary to get the best all-round results.



Symmetrical doublet made up from two achromatic telescope objectives

When using simple lenses, it is usually found that two matched lenses with the stop between them will give the best results—within the limitations of such lenses—but separation distance, size and position of stop, and the relative position of convex, plane or concave surfaces are all susceptible to experiment. Many users may be quite satisfied with the standard of projection obtainable with such lenses, which are often found in the less expensive commercial products; the general definition, though not critical, is not obtrusively bad, and the lack of achromatic correction does not show up seriously in monochromatic subjects, but may prevent colour films or slides being displayed to the best advantage.

Throw Distance

It is often found necessary to adapt the focal length of the objective to the particular conditions under which the projector is used. For home use, in an ordinary room, the size of picture which can be projected with an objective of the focal length suggested, may not be large enough, and a shorter-focus objective will therefore be desirable. On the other hand, when the projector is used in a public hall, it is generally desirable to locate it well at the back, so that it neither obstructs vision nor is it liable to become damaged through leads getting entangled with people's feet. In such cases, a long-focus objective may be called for, to limit the size of picture to that which can be properly illuminated, or to suit the size of screen available.

In order to assess the throw distance required to produce a given size of picture with a lens of given focus, the following formula may be used:

$$\frac{\textit{Picture on Screen (ft.)} \times \textit{Focus of Objective (ins.)}}{\textit{Diameter of slide (ins.)}} = \textit{Distance from lantern to screen (ft.)}.$$

For instance, assume that it is required to produce a picture 4 ft. wide on the screen, with an objective of 3 in. focal length. The diameter of the slide or film (across the maximum dimension) may be taken as 1 in., though it is slightly less—the difference may be allowed for margin on the screen. Thus: $\frac{4 \times 3}{1} = 12$ ft. throw distance. This formula is, of course, convertible to find any one factor in the equation, the other three being known, i.e. in addition to throw distance, it can be used to calculate focus of objective, size of projected picture, or size of slide. It is only approximately accurate, as the lens is not working at its infinity focus, but the error is small, and decreases as distance is extended.

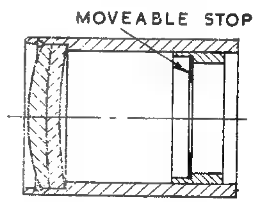
Supplementary Lenses

It may be useful to remember that some modification in the focal length of objectives can be obtained by the addition of supplementary lenses. This is often done in the case of camera lenses—as, for instance, by using a "portrait attachment" for close-up work with a fixed-focus camera—but rarely seen in the case of projectors, though equally applicable to this purpose. Either positive or negative lenses may be added to an existing lens system, the former having the effect of shortening the focus, and the latter of lengthening it.

There is some risk of upsetting the balance of a very highly corrected lens system by the addition of a simple uncorrected lens, but in most cases there is no perceptible deterioration of quality unless very considerable alteration of focal length is produced by this means. Ordinary spectacle lenses may be used for the purpose, and may often avoid the necessity of carrying two or three objectives of different focal lengths. The lenses may be mounted in cells having a sleeve extension to slip either over or inside the end of the objective lens mount as shown, or to screw on if this method of fitting is preferred.

The addition of an extra lens to the front or back of an objective will obviously displace the focal centre of the system, and this may possibly have unexpected and paradoxical results. For instance, the addition of a negative lens, although it will *always* increase focal length, will either increase or decrease the size of picture on the screen, for a given throw distance, according to whether it is fitted to the front or back of the objective! Thus, if it is desired to project a

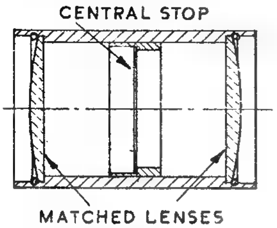
Achromatic singlet with front stop



larger picture in a room of limited size, a negative lens fitted to the front of the objective will enable this to be done; the same lens, fitted to the back of the objective, will enable the projector to be located farther from the screen in a large hall without increasing the size of the screen picture. In either case, the distance of the objective from the slide or film must be increased to bring the picture into correct focus.

It will be noted from the detail drawing of the objective housing on page 508 of the April 13th issue of THE MODEL ENGINEER that a helical slot is cut in the side of the housing to admit a pin for focusing the objective. This is a very simple and convenient method of focusing,

and in the case of lenses with plain tube mounts, it requires only the drilling and tapping of a hole in the tube, in a suitable position to take the focusing lever, the shank of which should be a neat fit in the slot, as shown in the drawing illustrating the use of supplementary lenses. Any other means of focusing may, however, be fitted at the option of the constructor; one method which is popular in cine-projectors is to cut a helical groove in the objective tube, to engage with a spring plunger or ball in the housing, and act as a quick-pitch screw thread, with just sufficient friction to prevent inadvertent movement.



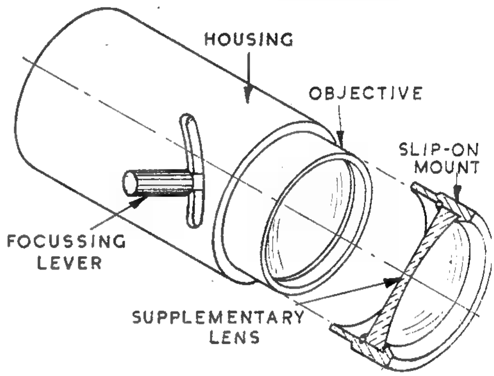
Symmetrical doublet using simple "spectacle" lenses

Available Material

Achromatic object glasses from telescopic gunsights and similar instruments, as used to make up the doublet described, are obtainable from the Aero Spares Co., 71, High Holborn, W.C.1., who also stock a variety of other surplus lenses and combinations suitable for adaptation as short-focus objectives for cine-projectors, etc. Messrs. H. Franks, New Oxford St., W.C.1., can supply surplus objectives of 2½ in. focal length, and plano-convex lenses suitable for condensers. The Miscellaneous Trading Co., Ltd., High Holborn, W.C.1., have a number of 35 mm. projector objectives of various focal lengths, also complete condensers and lens elements, either new or secondhand. Messrs. Broadhurst Clarkson, Ltd., of 65, Farringdon Road, E.C.1., also have several types of lenses available.

A price list describing a wide variety of ex-government lenses and other components for constructing all kinds of optical apparatus has been received from Messrs. H. English, Park Avenue, Hutton, Brentwood, Essex, who also issue printed instruction sheets, with diagrams, showing various instruments in which these components can be used. These products have not been personally inspected or tested, but from the specifications given, they appear to be of good quality, and suited to the purpose now under discussion; the prices are very low for components of this nature.

Castings and other parts for constructing the projector which has been described will be available from Messrs. Roox Products, Wellhouse Road, Beech, Alton, Hants, who hope also to be able to supply selected and approved lenses for the projector in due course. It should be clearly understood that the writer has no business connection with any of the firms mentioned above, and cannot be held responsible in the event of any complaints regarding their products.



Method of applying a supplementary lens to alter focal length of objective

(*To be continued*)

Novices' Corner

(*Continued from page* 753)

projecting pip. A sharp knife-tool with adequate side rake will take a deep cut when reducing the diameter of a round bar, but allowance should be made to take a finishing cut of only a few thousandths of an inch in order to give a satisfactory finish to the work. As soon as there is any sign of falling off in the quality of the finish, the tool should be examined and its cutting edges resharpened.

So far, only the form of tool suitable for turning steel has been described, but this tool, too, will cut freely and will give a good finish on aluminium alloys. For turning brass, the rake may be either reduced to some 5 deg. or abolished entirely, for although some degree of rake will give easier cutting of this metal, excessive rake may result in the tool's digging into the work.

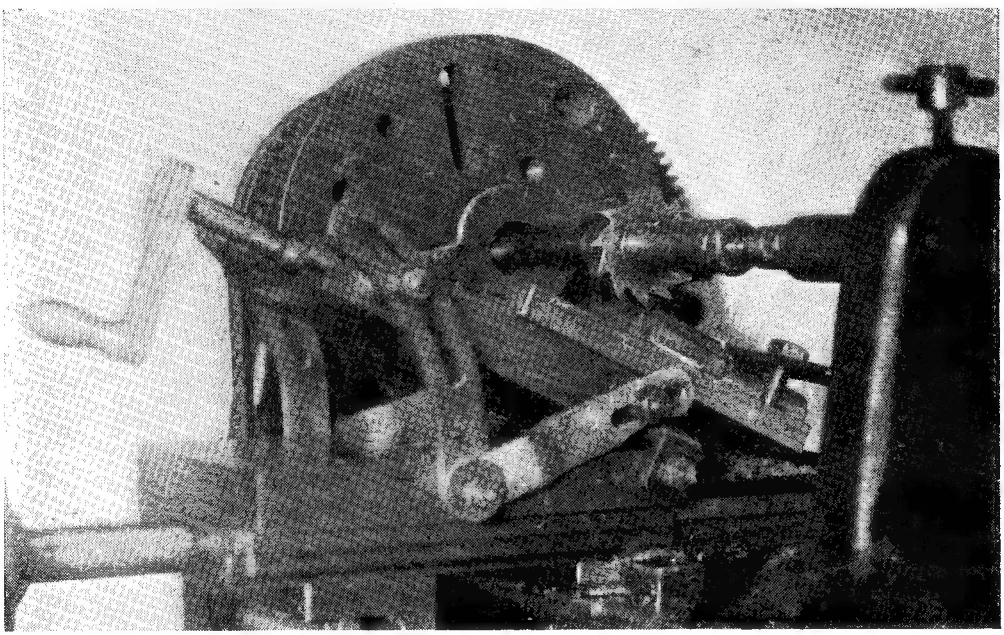
Gunmetal and bronze vary greatly in their machining properties according to their exact composition, and the most suitable rake and clearance angles may have to be found by experiment.

Some hard bronzes can be machined best when a negative rake angle is used, that is to say the upper surface of the tool slopes downwards towards the work, and not away from the work as with the usual form of rake.

A Multi-Purpose Milling Table for the Lathe

by H. H. Morris

NOT long after I started to build the 1 in. scale model traction engine, described in THE MODEL ENGINEER during 1933, by H. Greenly, I was somewhat taken aback at not being able to obtain some of the more important castings.



The milling table in operation

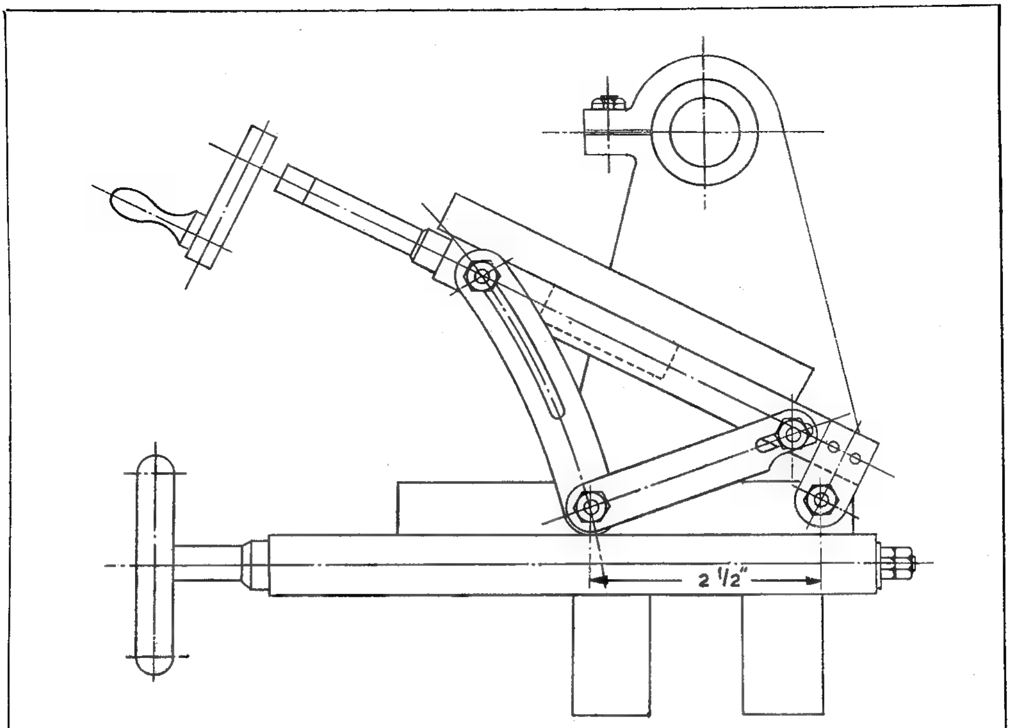
Although this difficulty was partly overcome by fabrication of the necessary parts, the wheels presented a more complex picture. Hubs had to be slotted and spokes made to fit exactly; it was therefore evident that a certain amount of machining would be inevitable, as I did not want to do all this by drilling and filing.

I had designed and built my own lathe, which is $4\frac{1}{8}$ in. centres and will swing $4\frac{1}{2}$ in. over the saddle; also, I had designed and built a very good sensitive drilling machine, so I thought I could design a milling table for the cross-slide which would fulfil all my requirements, and also make cutters to use with it. The following is the result.

The milling table has a built-up box base and sliding table; it can be used flat on the cross-slide, or tilted to any angle up to about 45 deg., and is quite rigid in any position. It can also be used as a vertical slide by fixing to an angle-plate. It has a traverse of $2\frac{1}{4}$ in. and can, of course, be used on any part of the lathe bed where the cross-slide will travel by the leadscrew. My lathe is not a screwcutting type, but has a traversing screw, and also a fully compound slide-rest.

I have thoroughly tested the milling table and found it exceedingly useful, and to any reader who has a flat-bed lathe, I would say, make one and try it.

The ends and sides of the box base ($\frac{1}{4}$ in. × $\frac{9}{16}$ in. finished), can be trued to square and length in a four-jaw chuck; the bottoms of both box and slide can be made from rolled steel plate and pieces for making up tee-slots, and slide can be of strip rolled steel; in my case they are made from pieces of frame taken from an old folding pram. The boss-piece under the slide is a piece of cast-iron, trued up square in the four-jaw chuck and was drilled for slide-bars and feed-screw first, partly through one way with the drill held in the lathe chuck and the back centre bearing in a centre-pop in the block, diametrically opposite to the hole being drilled. It was then reversed with the back centre in the hole partly drilled and finished completely through. Two



Side view of milling table fixed on lathe. (Not to scale)

outer holes were drilled 3/8 in. and the centre hole tapped 5/16 in. Whitworth. Before tapping, the front end was opened out to 5/16 in. clearance about 1/2 in deep ; this helped to ensure true tapping and left plenty of thread for the feed-screw.

The screw, Fig. 1, can be turned from 7/16 in. B.D.R. steel. Mine was made from a swivel-pin of an old motor-cycle front fork, and very good stuff too, taking a beautiful thread with the 5/16 in. Whitworth die. At the handle end it was left 2 in. long, turned to 3/8 in. diameter, leaving a collar a full 7/16 in. for the stop, and the end squared for the loose handle (Fig. 1A). My spindle was already squared, and I used a short lever ; also, with a squared hole the right size, which came off the hub brake of the aforementioned motor-cycle. I riveted a small turned handle into the other end of the short lever (see Fig. 1A). The other end of the screw was turned down to 1/4 in. and threaded 1/4 in. Whitworth (length between 7/16 in. shoulder and 1/4 in. end to suit overall length of box base), and a washer and lock-nuts fitted. The slide bars could be of 3/8-in. silver-steel with a 3/32-in. pin in one or both ends of each (see Fig. 4).

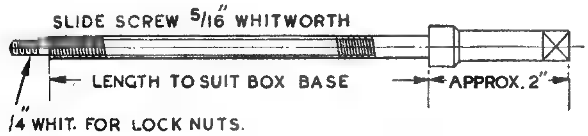


Fig. 1

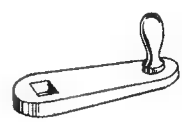


Fig. 1A. *Loose screw handle*

The sides and ends of the box base were pinned and riveted to the bottom with 1/8-in. steel pins, and could be sweated or brazed if facilities were available ; but if sweated only, babbit instead of soft-solder should be used, and this operation left until parts, to be described later, are fitted.

These consist of two small brackets at the extreme end of the box base, either straight vertical or angle fitments, according to whether the milling slide is to be the same width as the lathe cross-slide, or if it is to be narrower as mine is. If the same width, the brackets can be vertical and straight, and if narrower, they will have to be double angle brackets (see Figs. 2 and 4), and in either case must be so that the members which fit on to the lathe cross-slide really fit tightly and have no side play whatever. This is very important, as on it depends both the truth as regards traverse of the slide, and the rigidity of same. The fitting of the screws which hold it to the cross-slide are, of course, just as import-

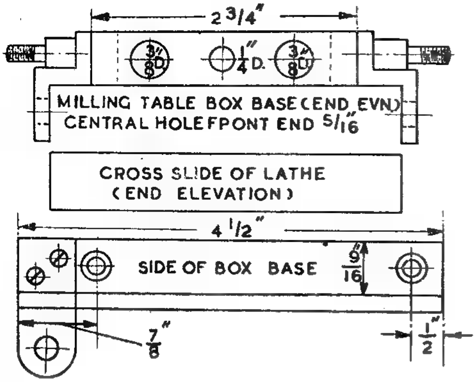


Fig. 2

ant, but this will be referred to later on. I think the drawing will make the shape and the method of fitting these brackets quite clear.

The slotted table, or slide, was built up from a piece of rolled steel plate 5/32 in. thick for the bottom, with ⅛-in. strip steel for tee-slots. Bottom strips, next to the bottom-plate, consisted of two outside ones ½ in. × ⅛ in., and the two middle ones ⅜ in. × ⅛ in. Top strips were all ⅝ in. × ⅛ in., each drilled and countersunk for five screws 5/32 in. Whitworth; the 5/32 in. holes were continued through the middle strips and were tapped in bottom and riveted over underneath in a slight countersink, then filed off flush. Three screws only were put into the two middle pieces at first, two at one end and one at the other. The four remaining holes were drilled clear right through and the cast-iron sliding member drilled and tapped to receive long

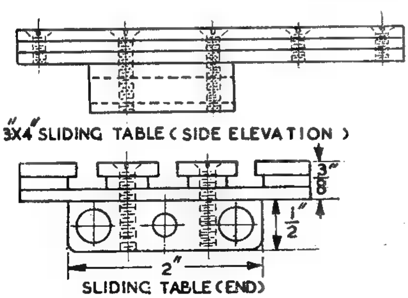


Fig. 3

screws, which come in the solid part between screw and slides. I have so fitted my slide that the top of the sides and ends of the box base act as a sliding support, as well as the circular slides in the cast-iron boss, thus adding greatly to the rigidity. I managed this by leaving the block slightly proud of the top of the box when fitted to slide bars and screw; then by carefully filing and scraping I got a good fit from end to end of the traverse. This took a little longer, but it was well worth doing, because when milling, rigidity and good fits in all slides are essential.

Fig. 5 shows the links for raising and lowering the table to any angle within the limit of the lathe.

The links are in pairs, the curved pair being exactly alike. The straight pair also are drilled and slotted alike, but each has a ⅛ in. set in it, one right- and one left-hand. Sizes of holes and slots are as indicated in the drawing. Each pair is fixed at the bottom ends with a hexagonal head, 9/32 in. shoulder, 1-B.A. threaded screw to a position somewhere about the centre of the lathe cross-slide; this position can best be found by trial. I worked mine out by means of a couple of strips of card fixed by drawing pins, with another piece cut to the size of the side of the cross-slide, but if a slide is made to my sizes the distance is 2½ in. from the centre of the

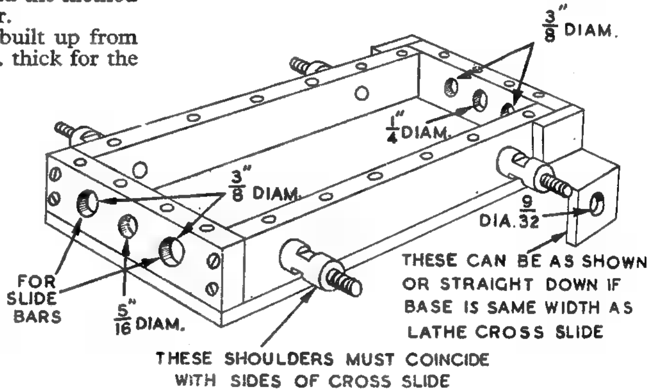


Fig. 4. Perspective sketch of box base. (Not to scale.) Sides of base ½ in. thick by 9/16 in. thick

swivelling pin in the angle fitting at the back end of the base. The shoulders of these screws are just short enough to permit locking securely when tightened up. The other ends of the links (slotted ends) fit on studs fixed into the sides of the box base (see Fig. 4), and are held by a nut and washer at whatever angle it is desired to set the milling table. These studs are, of course, really spacers to keep the links vertically in line. The angle-pieces at the end of the box base are fixed to the lathe cross-slide by two similar screws, so near to the rear end of same that on lifting the milling table to an angle, the box base just clears the corner of the cross-slide. If it should not, the square corner of the cross-slide could be rounded off a little; this would be no detriment to the cross-slide.

NOTE.—It must be particularly understood that the two rear tapped holes in the cross-slide should be in exact cross alignment, both vertically and longitudinally with the lathe bed, or the table will either bind badly or refuse to move up or down.

When all is fitted satisfactorily, the box base,

as mentioned before, could be sweated or brazed. If brazing, the two slide bars should be left out until the box is cleaned up afterwards. Brazing is not necessary, however, if all parts of the box are well squared and fitted before riveting. The sweating is, I find, quite satisfactory, as after a fair amount of use, mine is still sound.

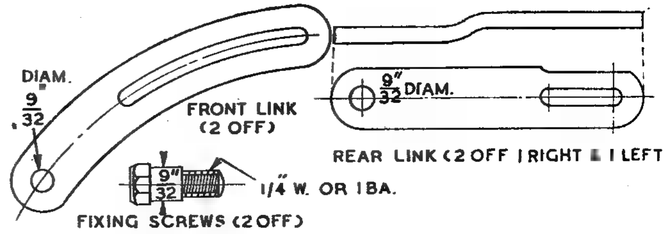


Fig. 5

By the way, I should have stated that in milling with the table set at an angle, the depth of cut can be governed by moving the whole thing with the lathe cross-slide. Setting up the job should be started with the milling slide fed along to its rear limit, that is, towards the back of the lathe, then when cutting, it can be fed towards the operator against the cutter. It will work quite well the other way, provided there is no sloppiness in the fitting up. I have had to do several awkward jobs feeding with the cutter. One particular job was milling all the spokes for the wheels of the traction engine down to 7/32 in. form ½ in. This I did by putting two slotting saws on a spindle between lathe centres, with a 7/32 in. turned spacing-collar between them and the ½-in. stock for the spokes on a little jig fixed flat on the milling-slide table with the length to be milled projecting towards the back. This end was, of course, supported by part of the jig which was filed slightly narrower than the spokes' finished size. There was no snatching or digging in, and the job was so easy and simple that my little grandson, aged 7 years, did quite a few of them, bolting and unbolting from the jig too, and when finished, without any filing, they exactly fitted the slots in the hub centres, which were cut on the same machine using a home-made cutter with filed teeth. It was made from a piece of sheet steel cut from an old plough.

Indeed, there seems no limit to the uses of this little table, and I wonder now why ever I did not think it out and make one before.

I work on my own, and am what has been called in THE MODEL ENGINEER a "lone-hand." I live right out in the country in a small village, too far from town to join any society. My inspiration, and I must add, my keen enjoyment has been in the past for many years, the reading and studying of the good old MODEL ENGINEER.

For the Bookshelf

Minimum Gauge Railways: Their Application, Construction and Working. By Sir Arthur Percival Heywood, Bart., M.A. (Padstow, Cornwall: Locomotive and General Railway Photographs.) Price 5s. net.

This is a copy of the text of a book which was published in 1898, in a limited edition for private circulation. It is an account of the origin and evolution of the 15-in. gauge railways which were installed at Duffield Park, near Derby, and Eaton Hall, near Chester, respectively; but there is, also, a considerable amount of information concerning narrow-gauge railways generally.

The reproduction has been done by stencilled typewriting on both sides of 48 pages of quarto-size paper, and has been admirably executed by Mr. C. R. Clinker. It makes most interesting reading, not only because the original must have been the first book to deal with sub-standard-gauge railways, but also because of the extent of the information given. Mr. Clinker, as copyist, has obviously enjoyed the labour involved in such an unusual task, and he is to be warmly appraised for his enterprise in making such a valuable and historical document available to a far wider public at so low a cost.

The original book contained several interesting photographic reproductions, and Mr. Clinker has had them all copied; prints are available in sizes from postcard to 12 in. × 10 in. from Locomotive and General Railway Photographs, Sales Section, 101, Talbot Road, Bristol, 4.

We feel that this production is a thoroughly worthwhile one, for every phase of the construction and operation of a 15-in. gauge railway is dealt with in considerable detail, and the information can scarcely fail to be of use to promoters of projected miniature, passenger-hauling railways of any kind. Books on this subject are rare, and the original of this one rarer still; therefore, Mr. Clinker's production is timely, in view of the growing popularity of the kind of venture for which it caters.

TEST REPORTS

Some expert comments upon items submitted by the trade

The Myford Machine Vice and V-Blocks

WHEN ■ machine vice is used on the drilling machine table or attached, for example, to the vertical milling slide, the work face of the vice should be exactly parallel with base surface, and the fixed jaw should stand truly at right-angles to these surfaces. Moreover, if the upper face of the fixed jaw is accurately machined, it can be used as a datum-surface when aligning the work. Only when these conditions are satisfied can the vice be employed with the certain knowledge that the work will be truly held automatically and, further, no time need be wasted in correcting errors of alignment by means of packing-strips.

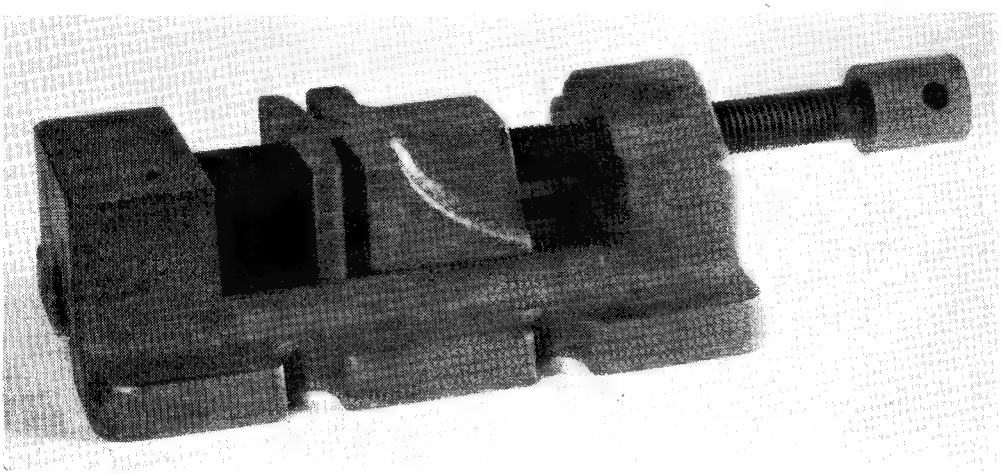


Fig. 1. The Myford machine vice with swivelling jaw in place

Although several patterns of small machine vices are now obtainable, not all of these have been found sufficiently accurate to satisfy the precise worker. The Myford vice, although of moderate price, is, however, exceptional in that it appears to fulfil all the requirements necessary for doing accurate machining. The vice here described was obtained in the ordinary way from ■ tool-merchant, and may therefore be regarded as ■ random sample of the work produced by the manufacturers.

The original form of the vice has been somewhat modified by alterations made to increase the holding capacity, and also to improve the mounting of the moving jaw. In its present form, the vice opens to fully 1½ in., whilst the depth of the jaws is now ¾ in., instead of ⅝ in. as formerly, but the jaw width remains at 1⅝ in. As the height of the work face above the lower surface of the soleplate is only ⅝ in., the vice is very compact and well adapted for use even on small drilling machines, or on the lathe faceplate or milling-slide where the small overhang is ■ valuable feature. Although neither jaw is furnished with a hardened, inset jaw-plate, this is no disadvantage in a small vice of this type, and it is certainly preferable to having ill-fitted jaw-plates that are difficult to correct.

To enable tapered work to be securely gripped, the moving jaw is provided with an accurately machined, detachable swivel-plate which pivots in a curved slot machined in the face of the jaw. A rectangular keep-plate, travelling in a slot machined for the full length of the base casting, is attached to the under surface of the moving jaw and serves, in part, to keep the jaw from rising when the clamping pressure is applied. The moving jaw was found to slide freely and smoothly, and without shake or appreciable tip; moreover, it is an easy matter to adjust the fit of this jaw by merely filing the abutment face for the keep-plate and then securely tightening the retaining-screw.

The main clamping-screw is case-hardened for its entire length, and the head portion is cross-drilled to take a tommy-bar; the screw is threaded ⅜ in. × 20 t.p.i. and has ■ well-fitting bearing ¾ in. in length in the casting.

Four open-ended slots are formed in the base casting to take $\frac{5}{16}$ in. diameter bolts; these have ■ centre distance of 2⅜ in., measured in the transverse direction, and are situated 1⅝ in. apart.

Testing the Vice

The flatness of its under surface was tested by applying the vice to the surface-plate, and the transfer marks obtained showed that there was good, even contact, indicating an accurately machined base surface free from any tendency to rock. To test the parallelism of the work surface with the base, the test indicator was applied in the manner illustrated in Fig. 3, and then moved both along and across the surfaces under examination. At the same time, the accuracy of the upper surface of both jaws was similarly tested, as represented in Fig. 4. The recordings, so obtained, over all parts of these surfaces showed no detectable variation.

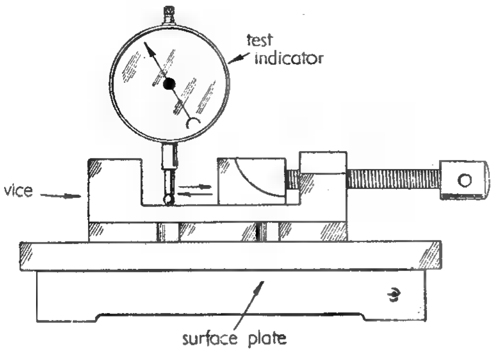


Fig. 3. Testing the work face of the vice

With the aid of a small toolmaker's try-square, the squareness of the fixed jaw with the work surface was tested and found to be correct. When firmly clamped together, the two jaws met squarely and evenly. A small steel block was then placed between the jaws, and, when the clamp-screw was fully tightened, the test indicator showed that the moving jaw rose only one thousandth of an inch ; even this small amount of lift could be reduced, if required, by adjusting the fit of the keep-plate more closely in the manner already described.

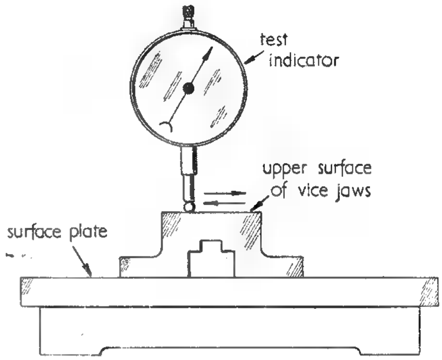


Fig. 4. Testing the surface of the vice aws

Conclusion

The tests carried out showed clearly that the vice is accurately machined and fitted, and there need be no misgivings as to its ability to hold the work squarely for drilling or milling operations. Some workers might prefer that the moving jaw

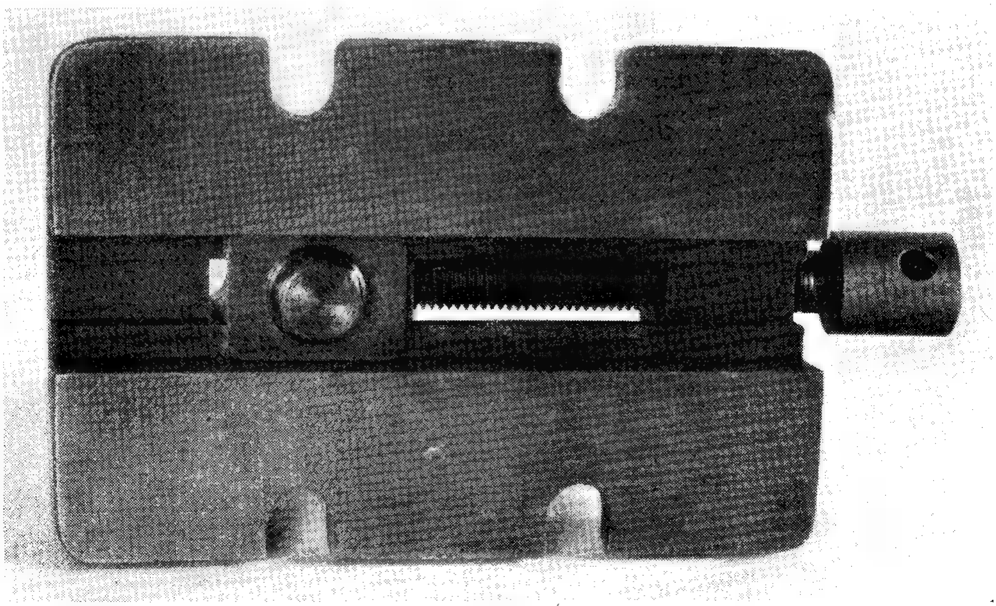


Fig. 2. Underside of the vice, showing method of guiding the moving jaw

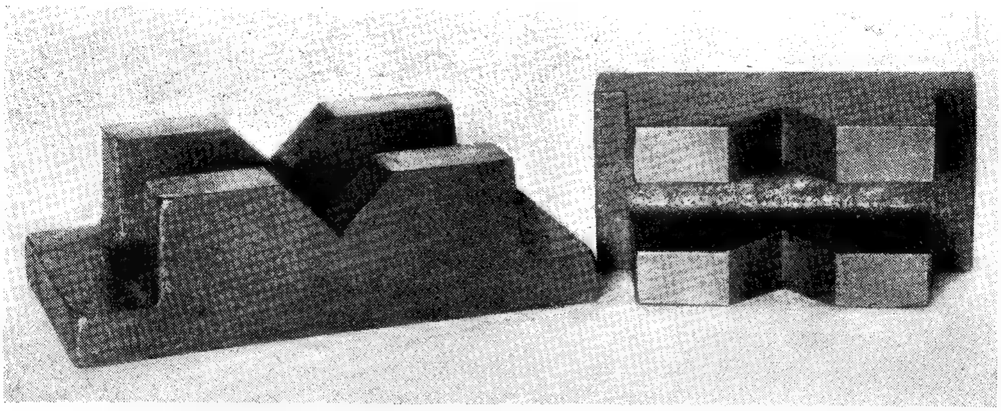


Fig. 5. The two sizes of V-blocks

should be retracted as the clamp screw is withdrawn ; this could quite easily be effected, either by fitting a grub-screw to the jaw casting or by using a circlip to embrace the tip of the clamp-screw, for very little pressure is required to move the jaw backwards. Although the soleplate casting appears to be flat and to have an even surface, spot-facing for the holding-down bolts would be a welcome refinement.

The painting of the particular vice under review appeared to consist of a single coat, and even this was missing in places, possibly as a result of damage in transit. Nevertheless, a well-made tool such as this deserves a better dress to enhance its attractiveness. However, in this connection, it is understood that the manufacturers are at present experimenting with a process for obtaining a smoother and more durable finish.

The Myford V-Blocks

These appliances, illustrated in Fig. 5, are made in two standard sizes, the larger being 4 in. long and 2 in. wide, and the smaller 3 in. × 1½ in. The double V-block will be found useful for mounting work in the lathe, on either the face-plate, the saddle, or the vertical slide. In addition, they provide a convenient means of supporting work on the table of the drilling machine, or on the surface-plate for marking-out operations. The under surface of the soleplate as well as the sides and wings of the V-slots are all accurately machined. Holes to take holding-down bolts can be drilled if required, and, to secure the work in the V-slots, bridge-pieces or straps can be used when clamped down by screws fitted to the upper face of the casting.

The machined under surface of the casting was found to be flat when tried on the surface-plate, and the accuracy of the V-slots was also tested on the surface-plate with a ground bar resting in the V's. As illustrated in Fig. 6, the test indicator was applied in turn to the two ends of the bar, but the precautions were taken of rotating the test bar to make allowance for any lack of straightness, and turning it end for end to offset any error of parallelism.

These tests showed that the bar was supported by the larger block with an error of parallelism within two-thousandths of an inch measured

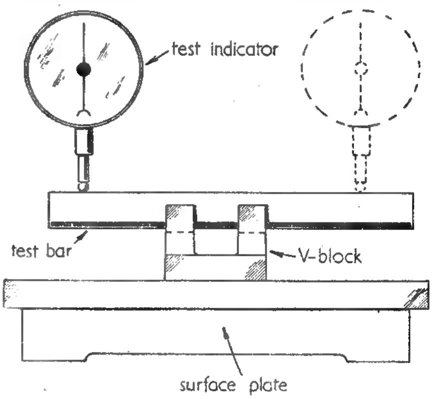


Fig. 6. Testing the V-block on the surface plate

over a length of 3 in., whilst the smaller block gave like readings under similar conditions.

The machined surfaces of the blocks are well finished, but, again, the general appearance would be enhanced if the standard of the paint-work were correspondingly good.

Plate Bending

H. Dodson writes :—" With reference to the 'Practical Letter' with illustration in THE MODEL ENGINEER dated May 4th, on the above subject, I should, in response to the invitation of the writer, like to record my interest in the subject and would welcome a fuller description of the little machine."

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

I FEEL that perhaps I did not make one point sufficiently clear regarding the sand boxes. On the prototype, these are cast and so all the corners are pretty well rounded. The drawing shows this quite well, although no dimensions are given for the corner radii.

The drawing this week shows details of sand traps and ejectors, and it might be worth while dealing with the subject to some extent, in order that builders will understand the principles involved.

The gear used on this engine is known as the dry sanding system, and is extensively used. One of its greatest disadvantages lies in the possibility of the ejected sand being blown away before it reaches the actual rail head. In a high wind, this may quite easily happen, and then you are liable to have the wheels gripping the rails on one side, and still tending to slip on the other, with the result that the heavy strains imposed unevenly between the wheels may cause a cracked or even broken axle—it *has* happened, more than once, in full size.

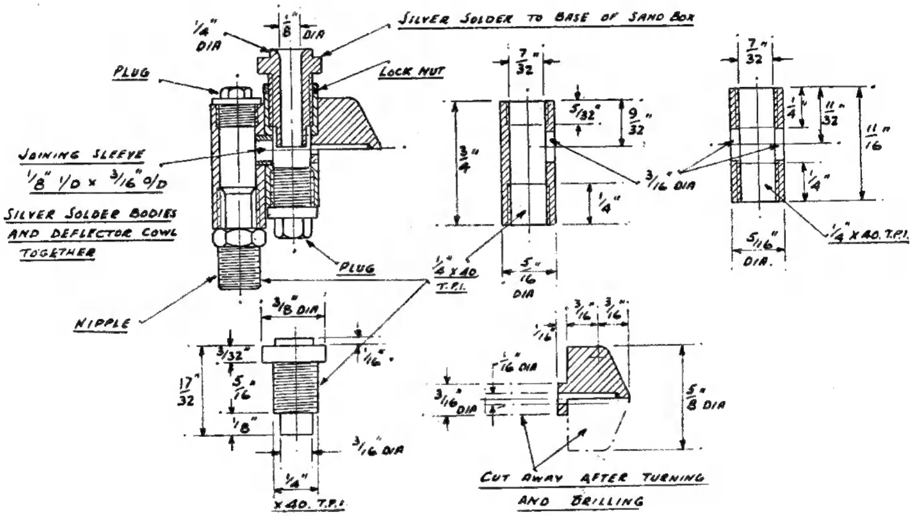
To get over this difficulty, a wet sanding system was introduced; operated by hot water under boiler pressure, and being worked via jets in a kind of trap immediately below the sand hopper or box, and so washing down the pipe a kind of wet slurry of sand and water mixed. There is very little danger of this sloppy mixture being blown away, and less chance of dry sand being blown into the motion joints which, to my mind, is the more important consideration.

I dare say this latter system could be made to work on a miniature locomotive, but it would be, in all probability, pretty wholesale in matters of sand delivery, and messy into the bargain.

Dry sand is not so very much better to deal with, mainly because it has to be *absolutely* dry, and once it has become even slightly damp, it begins to hang together and will not flow down the sides of the sand box, or through the nozzle of the trap, and certainly never down the sand pipe itself.

This difficulty is also very real in full scale practice, and the shed boys have to empty the boxes at frequent intervals, and replace it with fresh sand, dried in special ovens or trays in the engine sheds. To keep anything bone dry on a small locomotive, is a bit of a problem; not because of minor water leakages finding their way about, but for the general state of steam and humidity that abounds.

The sanding gear designed for our engine, works on exactly the same principle as the full



SAND BOX TRAP. 4 OFF. IN BRASS OR G.M.

*Continued from page 684, "M.E.," May 11, 1950.

size gear, and if you take another look at the drawing you will see first of all a sectional view of the sand trap which fixes on the bottom of the sand box.

This comprises two main chambers ; the right-hand chamber screws on to a kind of broad nozzle, through which the sand pours until it forms a little pile, resting on the stop plug below. The sand will not rise up round the sides of this nozzle, nor overflow through the side openings provided, unless violently agitated. The height of the nozzle aperture can be varied by screwing or unscrewing the top member and locking up again by means of the thin locknut provided, when the best working position has been found. This same chamber has two side openings, the left-hand one leading into the second left-hand chamber, and the right-hand one leading via a smaller hole, to atmosphere, and under a sort of cowl or deflector, the outline of which simulates the full size air cowl and deflector combined.

The left-hand chamber does little more than provide a collection chamber for the sand, and there is a top access plug to enable the pipe and passage to be cleaned and dried. The plug at the bottom of the right-hand chamber is to enable you to empty the sand box completely, should this get wet or out of condition. From the left-hand chamber runs the sand pipe, free from sharp bends or corners, and giving no harbouring space for sand to stick. This pipe runs into the ejector—also shown in section, and so away to the tail pipe disposed a little above the rail head, and in line with the wheel it serves.

When steam is turned on at the ejector, a partial vacuum is created, in the sand pipe and air rushes into the only free port provided—the right-hand opening under the cowl or deflector. The aperture is reduced here so that the incoming air forms a jet, playing directly at and round the tiny pile of dry sand formed under the main nozzle. This jet carries away some of it which then is swept down the pipe, and out with the jet of steam. The reduced pile of sand in the trap is constantly made up by a fresh fall from the box above.

It looks pretty well foolproof, doesn't it? Well, it *isn't* ; in fact, its anything *but* foolproof, but if you want to mess about with a lot of beastly gritty sand, that's your look out.

But seriously, if you want to fit and use sand boxes and all the gear described, there are one or two points to be watched and observed, and this is the unpleasant ritual.

Remove all sand from the boxes after every steaming, and place it in a container ready for drying off for the next time. Dry out the pipes and system as far as possible. Make sure that the sanding gear steam cock or valve shuts 100 per cent. and nothing less—this is the cause of more trouble than anything else, and the valve that lets the stray wisp of steam or bubble of water collect in the ejector will soon have a sand pipe nicely soaked and ready to cake the first time the ejector is used, so if you think you have the answers to these points, then you are well on the way. Years ago, when I first started to play with sanding gear, I ran into all these troubles plus a few more not mentioned, but I did find out that a little quick-lime mixed with the sand, did much to keep things dry for short periods of say two or three hours—enough for an afternoon's run, for example, and towards the end of my experiments, I always used such a mixture without damage to myself or the engine.

Finally, the point I wish to make about the whole bag of tricks, is this. It is nice to know that you have an engine fitted with proper sanding gear that *will* work if needs be. Beyond that I have my own views ; my engines seldom slip at all—even when wildly loaded and working in the pouring rain, and literally hundreds of people can testify the truth of my statement, and only one of my engines was fitted with the gear. I never had any occasion to use the sanding, but the engine went to America in 1927 and nobody seems to know what became of her.

Making the Fittings

The sand trap unit is fabricated as shown. The top nozzle unit is silver-soldered into the box, and is there for keeps ; don't forget to flare the entry into this fitting, to allow the sand to flow easily down the nozzle. The thin locknut of about $\frac{1}{16}$ in. thickness, can be made from hexagon brass rod. The two chambers can be made from $\frac{5}{16}$ in. brass rod, drilled and tapped as shown, and a small connecting sleeve made to join the two parts ; this helps when silver-soldering, and keeps the transfer passage in line.

The cowl or deflector can be dealt with in two ways ; firstly it can be turned up as one piece, halved, leaving the small turned collar intact, or it can be left in its complete state and the halving operation carried out after it has been silver-soldered in place—I think I favour the latter, as it gives you something by which to hold it. You should be able to do the silver-soldering all at one setting.

The two plugs are simple enough, and are shown with hexagon heads. Very small square heads with a turned collar beneath, should look even neater, and as nothing has to be screwed up very tightly, the small squares should stand the racket of doing up and undoing without getting torn about too much.

There is also a nipple to make—this would be from hexagon brass rod, and care should be taken once more to see that it has a well flared entry, to avoid sand building up on the projecting ledge. Whilst doing these parts, the same material will make the union nuts to go on the nipples, and tiny brass or copper rings should be turned up to make the wee collars that serve for nipples on the sand pipes.

Sand Ejectors

These are also simple parts to make, brass rod being a suitable material. One end of the body part is drilled to take the $\frac{3}{16}$ in. dia. pipe, whilst the outside is shaped down to give some relief to the otherwise rather hard outline of the fitting ; appearances the only reason here, and the other end is drilled and tapped as shown, whilst the brass nipple portion that carries the tail pipe hardly needs comment, except that it should be as scanty as possible, also to keep the fitting as small and neat as possible.

The piece of bent pipe that forms the steam

jet, should have its end properly turned to the same taper as the nipple into which it plays, and the hole in the pipe end should be trued with a small drill of about the same size as its " natural " bore, just to ensure roundness at the aperture. When the pipe is bent, see that there is a small section of it left straight—just behind the jet end, and then you can make up a simple jig fitting to hold the pipe truly and centrally during the silver-soldering operation.

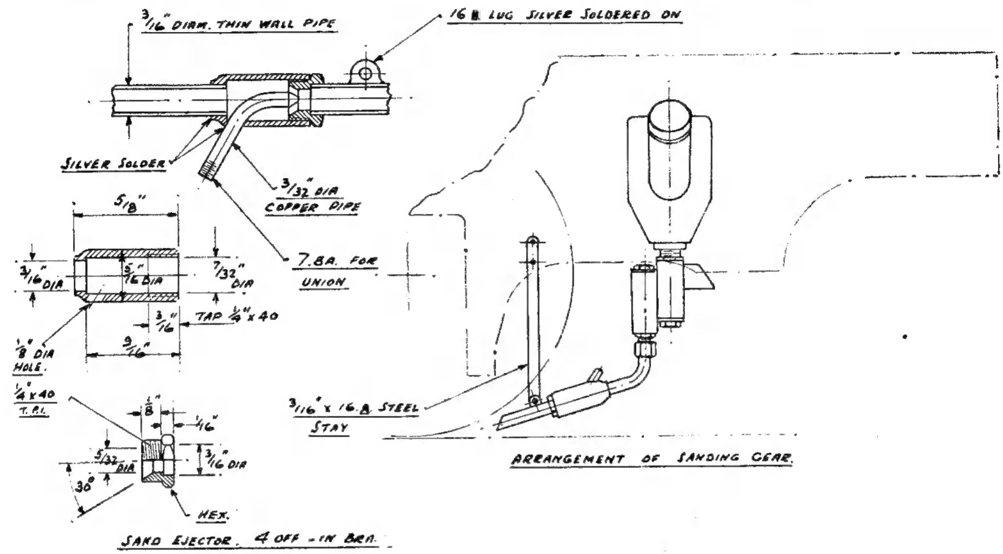
This is nothing more than another nipple, slightly longer than the proper nipple, and drilled to slip over the jet pipe at its parallel portion. It should be left in place while the joint is made, and afterwards taken out and the proper nipple replaced. Don't be too lavish with either silver-solder or flux, or you may find that the temporary jig nipple has come to stay.

All this overhang of pipe and fittings calls for a little stay back to the frames, just as it is on the prototype; the only difference being that we silver-solder a tab to the tail pipe, to take the stay, and the prototype has the stay steel bent round the pipe, and a pinch bolt to grip it. You may prefer to do the job in the latter style; it will certainly be the correct job.

The final diagram shows the general disposition of the assembled gear on the frames, the rear set of boxes being illustrated. This is not the only allowable arrangement, for being a working item we are permitted to make some variations; for example, we may find it more convenient to have the sand trap fitting round the other way—that is, with the deflector facing forwards instead of backwards. This gives a better run for the sand pipe, and a less acute bend than that shown. You could also turn the fitting so that the cowl was looking away from the engine, bringing the pipe centre line on the same centre as the sand box, but with the pipe thrown farther from the engine frames.

Exactly the same conditions apply when you get to the forward sand boxes. In this case, the pipes will have to run in a gentle sweep, in *front* of the forward brake stretcher, and with an outward set at the same time, so as to get into line with the rail head and wheel.

The very next job after all this is to take the frames apart for the drillings prior to final assembly, so find the positions for the sand boxes scribing through at least one of the fixing holes for future clues to position. The stays that bolt to the frames cannot yet be finished, but when the frames are down, small holes should be made close to the horn cheeks, just as the drawing shows, and the stays made up from the top downwards—so to speak, making up the lower or free ends to engage with the tail ends of the sand pipes. It looks as though another word of caution is needed here. When the engine is fully depressed on its springs, the lowest tip of the sand pipe should clear the rail head by about $\frac{1}{8}$ in. This can be done by holding the sanding gear units complete to the frames by means of large clamps, and setting and adjusting the pipe lengths to suit the stated conditions of depressed springs; I wonder if I have made that sufficiently clear?



Painting

The sand boxes are pretty well true to scale, but the rest of the gear is a little over scale for working reasons. In view of that I feel too much attention should not be drawn to them, and matt black for the rear units is my choice. You could leave the plugs and nipples bright if you wanted to, but the pipes and stays should be black. If that lure of a bit of bright copper pipe gets the better of you, then restrict it to the tail pipe portion only.

The front boxes inside the frames should be red—including the traps, and with the plugs

and nipples bright. Pipes and stays should again be black and the lids of *all* boxes black.

There is just one final word for the "dummy" folk; pipes that will never be used would look better in 5/32 in. diameter instead of $\frac{3}{16}$ in.—this would be almost the exact size, and dummy ejectors would be little more than a rounded swelling on the pipe. Whether working or not, the steam entry connection to the ejectors should be inwards and slightly upwards, to give a nice easy connection for the feed pipes that will follow later on.

Finale on Fabrication

Always having championed the case for fabrication, I feel, quite acutely, the passing of our late friend, Mr. A. W. Marchant. He was probably one of the finest exponents of this fine and skilled art. And what a kindly and lovable character he was, too; several times he came to sit with me while I was ill, and sat chatting of this and that to cheer me up. So I lose a friend, and the model engineering folk lose a kind and clever engineer—it's all very sad.

(*To be continued*)

PRACTICAL LETTERS

Turning Plastics

DEAR SIR,—Mr. Blandford's article—"Turning Plastics" in THE MODEL ENGINEER, April 27th, was of especial interest to me, as I have had occasion recently to try out the plastics he mentions in his article. I found the phenol resin rather prone to chip, in a glass-like manner, till one applied the tool correctly (and gently) when nice wide shavings were the result.

As most lathe chucks are bell-mouthed a little (mine is no exception), I found it an advantage to wrap a thickness of paper round the material just at the mouth of the chuck, thus compensating a little for the mis-alignment of the chuck jaws. The material, when held in this manner, responded very well to the proper application of the tools. Many thanks, Mr. Blandford, for an interesting article.

Model Vertical Boiler

And now, may I digress a little, and offer my thanks to "L.B.S.C." for the very excellent drawing and detail of the vertical boiler in the same issue? I've been looking for something like this for a long time, and it is just "what the doctor ordered." Would it be too much, to ask for details of a good stationary engine from the gifted pen of this gentleman?

Yours faithfully.

Glasgow. R. JOHNSTON.

Sharpening Drills

DEAR SIR,—The subject of drill sharpening seems to crop up at regular intervals in THE MODEL ENGINEER, and I cannot understand why this should be so. If anybody wants to file an angle on a piece of steel, he does not want a filing fixture. He either holds the file at the angle or places the work at an angle and goes ahead and files. So with drill sharpening. It is just a case of presenting the drill to the grinding-wheel or oil-stone at the required angle, and surely that is simple enough. It just requires a little thought and care.

Apparently many of your correspondents have been frightened by the "Right and Wrong" sketches one sees in articles on drill grinding and the oft repeated warning that the edges must be the same length, angle, etc. While this is true to a certain extent, it is not essential, and it doesn't matter two hoots if they are not identical. On many occasions, it is an advantage.

It is very seldom that a drilled hole is required to be dead on size, so if the two edges of the drill are a shade out, it will not do any harm.

I have drilled holes up to 3/32 in. bigger in diameter than the drill size, by judicious "winging" of the drill, that is, making one edge longer than the other; a big help when one has not got the right size drill. It is also a big help when drilling phosphor-bronze, which has a nasty habit of binding on the drill.

If it is necessary to have a drill cut right size, use a smaller drill first and open out with the required size drill. I use this method for fitting silver-steel locating dowel pins in jigs and fixtures, and the fit is perfect.

I have sharpened drills from No. 60 to 2 in. diameter, by hand, and by checking the angles and edges by eye, I have never had the slightest trouble with them. I frequently sharpen smaller sizes on an oilstone by holding them at a suitable angle between my fingers and then rubbing them up and down.

It doesn't matter if the "land" is flat or curved, as long as the trailing edge is not in advance of the cutting edge.

I am not advocating carelessness in drill sharpening. An endeavour *should* be made to keep the edges and angles identical, but if the modelmaker has difficulty in accomplishing this, it doesn't matter. He will still drill a hole with the edges uneven.

If it is a tapping size drill that is being sharpened, it is an advantage if it cuts bigger than size. I, personally, always use a wire drill one size larger than the one recommended for B.A. tapping. It saves broken taps and still gives ample thread for all practical purposes.

Yours faithfully,

Germiston, S.A. D. F. HOLLAND.